Compressed Air Magazine

TJ
981
C7
v.26
no.12
Mechanical
Engin.

Vol. XXVI, No. XII London New York Paris 35 Cents a Copy

DECEMBER, 1921

CIRCULATION THIS ISSUE
13,500 COPIES

DRILLING ROCK UNDER WATER WITH PARTIALLY SUBMERGED "JACKHAMER" DRILL

The Recreational Phase of a Great Industry
Eugene P. McCrorken

Early History of Gold and Diamond Mining in South Africa
C. A. Lagesen

Great Lakes-St. Lawrence Tide-water Channel
William L. Saunders

The Making of Blown and Pressed Glass
Robert G. Skerrett

[TABLE OF CONTENTS AND ADVERTISERS' INDEX, PAGE 5]

Stowe PORTABLE Niagara Devices

for better, faster and cheaper

SAND BLASTING and PAINTING

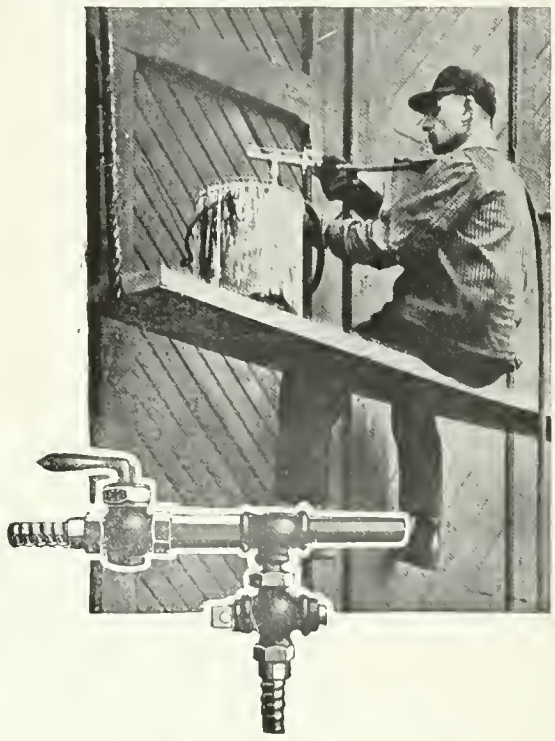
Stowe PORTABLE Niagara Sand Blasts and Pneumatic Paint Sprays do all that high-priced, stationary tank apparatus can do, and more which they cannot do. Because of their portability and simplicity Niagara Devices can be taken to the job, insuring more rapid, effective and economical work at 1/20th the initial and upkeep costs.

STANDARD SIZE SAND BLAST **$30.00**
Weight ..... 8 pounds
Hose (suction) ..... 1½ inch
Pressure ..... 80-90 pounds

For heaviest operations: Suitable for cleaning steel cars, bridges, viaducts, buildings, tanks, oil pipe lines, rail-ends, ship hulls, castings, concrete work and all other heavy operations.

MEDIUM SIZE SAND BLAST **$18.00**
Weight ..... 6 pounds
Hose (suction) ..... 1 inch
Pressure ..... 60-70 pounds

For grey iron, aluminum, brass foundry and all lighter work.



PAINT SPRAY **$12.00**
Weight ..... 2 pounds
Hose (suction) ..... ½ inch
Pressure ..... 40-50 pounds

Unsurpassed for painting steel cars and other railroad equipment, ships, buildings, steel structures, bridges, viaducts, tanks or any other surfaces now treated by the brush or dipping process.

Utilized in automobile body plants for applying first coats or primer. In all plants for general painting, whitewashing or cold-water paintings; brightening up the dark places, etc. In shops and garages for cleaning off motors or machinery in general with any solvent.

In foundries the Niagara Paint Spray will be found invaluable for blackening molds and spraying cores.

Shipped via Express or Parcel Post on 10 Days Trial f. o. b. Buffalo, N. Y. (U. S. only)

No tanks are required with Stowe PORTABLE Niagara Devices. The sand is syphoned direct from the pit, barrel or pile; the paint from any convenient container.

Every day sees more of these PORTABLE Devices distributed in Automobile, Boiler, Bridge, Car, Chemical, Contractor, Distilling, Electrical, Foundry, Government Plants, Iron, Locomotive, Machine, Mining, Packing, Pipe, Power, Quarry, Railroad, Refinery, Rubber, Ship, Steel and Textile Plants.

If it's sand blasting or painting enter your order now or request complete information and bulletin from

GEORGE M. STOWE, Jr.

MANUFACTURER

65 Main Street, Buffalo, N. Y., U. S. A.

Which Hose Will Last Longest Here?

These men are scattering razor-edge chips all over the floor and then dragging their hose lines over the chips—then probably tramping all over the hose.

That's only normal use—but it takes mighty good hose to last any length of time.

Look at the pictures below.

Finish this advertisement yourself!

Ordinary pneumatic hose. No trouble to whittle off slivers from cover with knife

On "Commander" blade slips and slides — can't get a hold

THE B. F. GOODRICH RUBBER COMPANY, *Akron,* OHIO

Goodrich

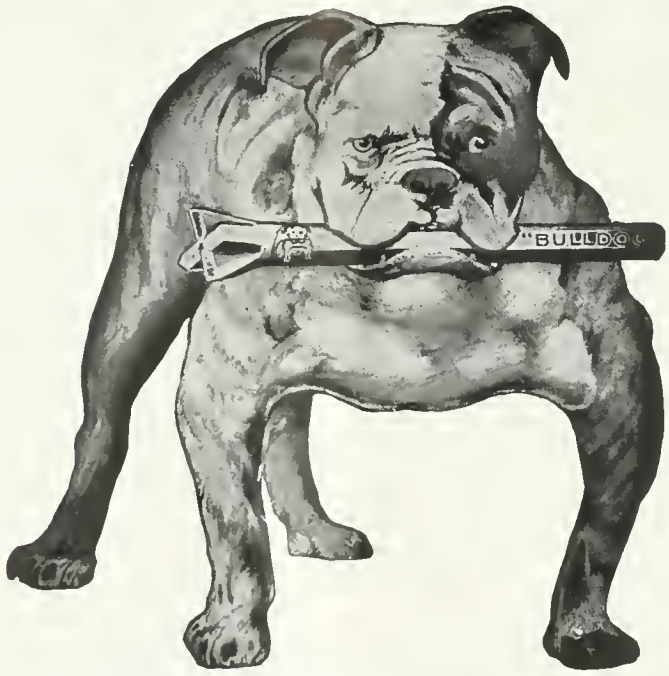
"Commander" Pneumatic Hose

Use Only

"BULLDOG" STEEL

"It Reigns Supreme"

HOLLOW AND SOLID



EVERY SIZE IN STOCK

Trada Mark. Reg. U. S. Pat. Off. 1911

"Bulldog Special" Hollow Drill Steel is used with all Drills, wherever the BEST is needed.

Manufactured only by the

International High Speed Steel Co.

Main Office and Works—Rockaway, N. J. New York Office—99 Nassau St.

As a matter of reciprocal business courtesy help trace results

CONTENTS OF THIS ISSUE

Vol. XXVI, No. XII, December, 1921

NOTE—For subscription terms see first Editorial page

Articles

The Recreational Phase of a Great Industry—*E. P. McCrorken*.... 10307

South African Rock Cores..... 10318

Automatic Separation of Nitrogen 10318

For Detecting Carbon Monoxide.. 10318

Great Lakes-St. Lawrence Tidewater Channel — *William L. Saunders* 10319

Taking Indicator Diagrams—*P. A. Baumeister* 10322

Oil Shale Deposits in the Rockies 10322

Early History of Gold and Diamond Mining in South Africa—*C. A. Lagesen*..... 10323

A New Sand Blast Barrel..... 10326

An Electro-Pneumatic Signal System 10326

Tests of Paint Spraying..... 10326

Just as Good For Air Pipe..... 10326

The Making of Blown and Pressed Glass—*Robert G. Skerrett*..... 10327

Fumigating Freight Cars at the Mexican Border—*S. R. Winters*. 10332

Radiant Heating for Comfort.... 10334

Preparation and Storage of Mine Timbers 10334

New Type of Belt Driven Air Compressors 10334

Notes of Industry..... 10335

Editorials—Tariff Increase on Drill Steel a Detriment—The Human Handicap in Record Making—Improved Methods for Oil Recovery—Chemists Pay Honor to Priestley—Song of the Reef at Johannesburg—Air Tests in Vehicular Tunnel 10336

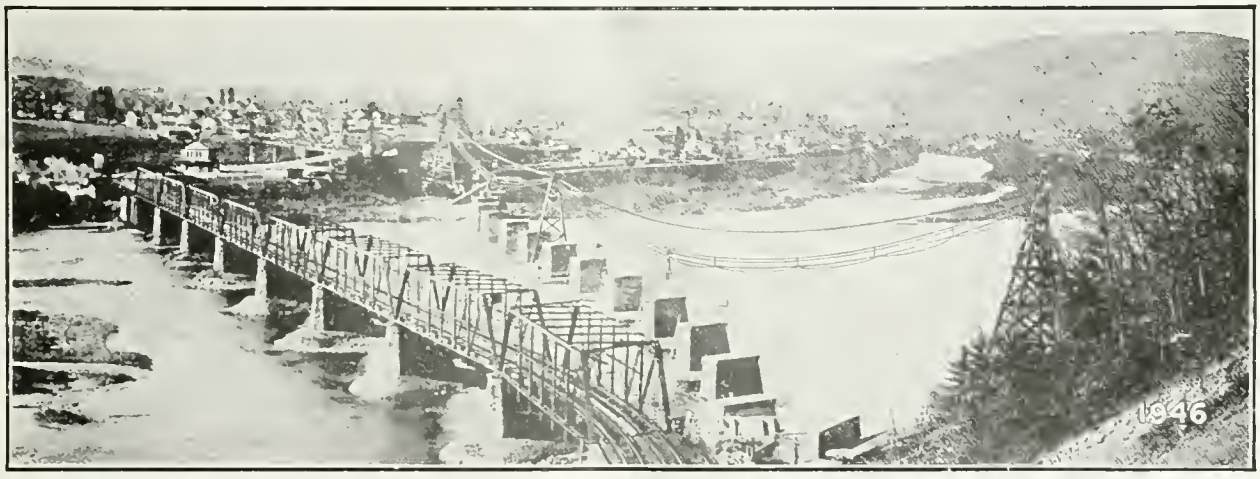
Book Reviews 10339

Pneumatic Drill Operates Oil Pump 10339

Pneumatic Patents 10341

Advertisements

Bury Compressor Co..... 14
Cameron Steam Pump Works, A. S. 8–17
Chicago Pneumatic Tool Co..... 20
Cook's Sons, Adam..... 16
Cooper Co., C. & G..... 16
Gardner Governor Co..... 10
General Electric Co..... 9
Goodrich Co., B. F..... 3
Griscom-Russell Co. 19
Hercules Powder Co.....Back Cover
Ingersoll-Rand Co. 6–7–21
International High Speed Steel Co. 4
International Trade Press..... 13
Jarecki Mfg. Co..... 18
Jewett 18
Keystone Lubricating Co..... 18
Lake Superior Loader Co..... 11
Lidgerwood Mfg. Co..... 5
New Jersey Meter Co..... 15
Pangborn Corporation 14
Perfection Washer 18
Powell Co., The Wm..... 19
Sprague Electric Works..... 14
Stearns-Roger Mfg. Co..... 15
Stowe, Geo. M., Jr..... 2
Terry Steam Turbine Co..... 12



LIDGERWOOD CABLEWAYS

Two Tandem Lidgerwood Cableways building bridge near Towanda, Pa.
For Lehigh Valley R. R.—S. B. MUTCHLER & CO., Contractors.

Cableways work over a single span up to 2,000 feet and provide an efficient method for hoisting and conveying material without interference to work and traffic under the span.

HOISTS

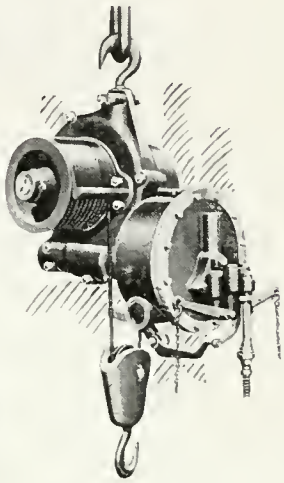
STEAM—ELECTRIC—COMPRESSED AIR—GASOLENE

LIDGERWOOD MANUFACTURING CO., 96 Liberty Street New York

PHILADELPHIA PITTSBURGH CHICAGO SEATTLE CLEVELAND DETROIT LOS ANGELES LONDON, ENGLAND

"LITTLE DAVID"

Foundry



Air Hoists

"Little David" Air Motor Hoists operate without jerks, jars or vibrations. They are ideal for handling flasks and for other general hoisting work. They positively hold the load at any point without slip. The entire working mechanism is enclosed, protecting it from dust and sand. Oil added to the crank case automatically lubricates all the parts. Five sizes, 1000 to 10,000 lb.

Sand Rammers

For practically twenty years "Little David" Sand Rammers (formerly known as Crown) have been standard equipment in many foundries, both large and small. Their ability to reduce ramming costs has been shown in hundreds of shops by actual working tests. Improved materials and refinements in their construction today make them still the leading sand rammer of the world. With a "Little David" Sand Rammer one man will do as much work as three to five men can do by hand and do it better. Each rammer gives long and reliable service.

Ingersoll-Rand
11 Broadway
New York

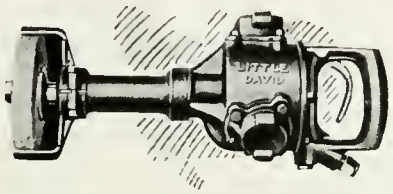
Offices

Ingerso

Pumps *Air Compressors* *Oil Engines*

As a matter of reciprocal business courtesy help trace results

PNEUMATIC TOOLS
Standards



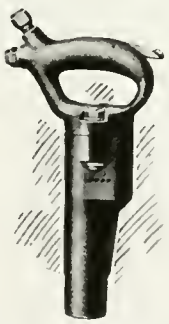
Grinders

The "Little David" Grinder has proved on all classes of work that it will do more work and cost 50% less to maintain than any other grinder. This is a remarkable record but is wholly due to the special features of this machine. There is no other grinder in which the entire mechanism is so simple and every part so rugged. This grinder is made in two sizes, for light and heavy work.

Core Breakers and Chippers

"Little David" Core Breakers save both time and labor in breaking out cores. They are rugged tools, able to stand much hard work and are not affected by the dust and dirt in which they have to operate.

For general chipping and cleaning work "Little David" Chipping Hammers are without equal. Special features make them very strong and easy to maintain. The handle and barrel are two drop forgings of great strength, reducing breakage. The handle is bolted to the barrel by two bolts, avoiding threads which strip or do not hold. A complete range of sizes.



Company
165 Queen Victoria St.
London, E. C. 4

Everywhere

231-PT

11-Rand

Steam Condensers ***Rock Drills*** ***Drill Sharpeners***

Standard Mining Equipment

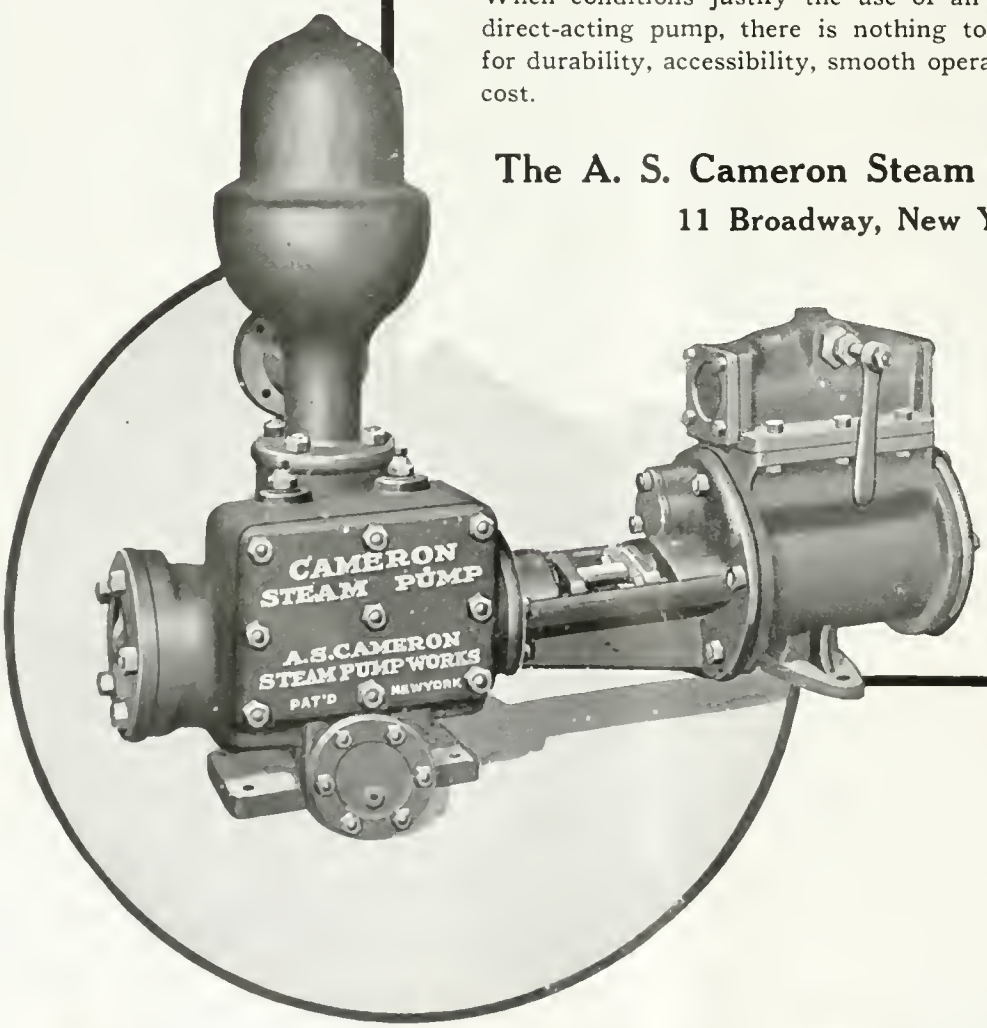
Long life is characteristic of Cameron Direct-Acting Pumps. They will operate year after year economically and without trouble. Many Cameron Direct-Acting Pumps have been in service for thirty, forty or even fifty years and are still giving satisfactory service.

Cameron Direct-Acting Pumps are standard mining equipment. Wherever necessary, these pumps can be fitted on the water end with an acid resisting metal which insures protection against chemical action.

When conditions justify the use of an air or steam driven direct-acting pump, there is nothing to equal the Cameron for durability, accessibility, smooth operation and low upkeep cost.

The A. S. Cameron Steam Pump Works
11 Broadway, New York

Write for Bulletin 7304

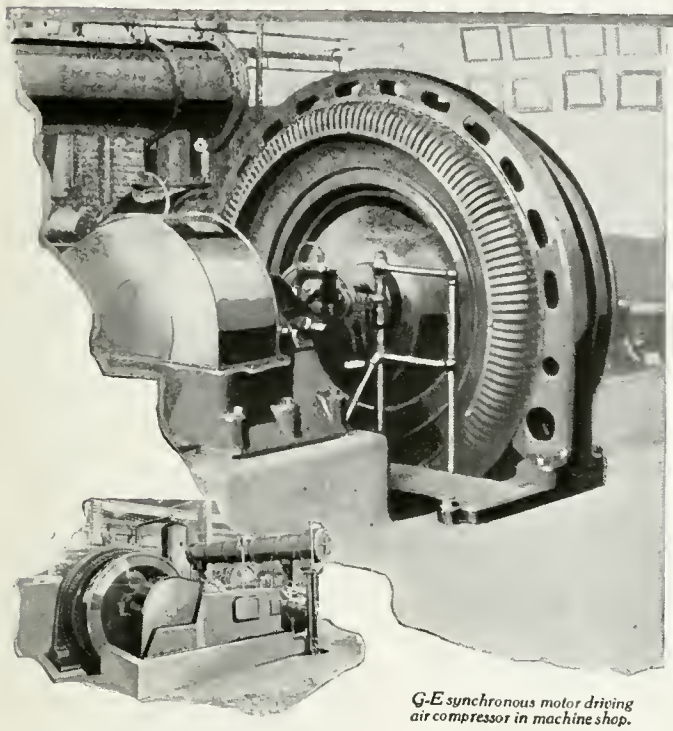


112-S

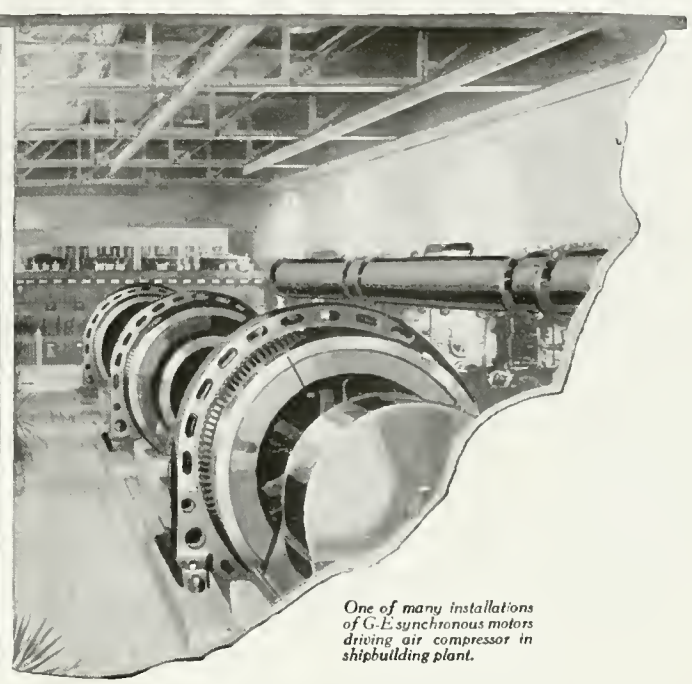
Cameron Pumps

As a matter of reciprocal business courtesy help trace results

In many mills, factories, and shops—synchronous motors are as essential to economy as good management

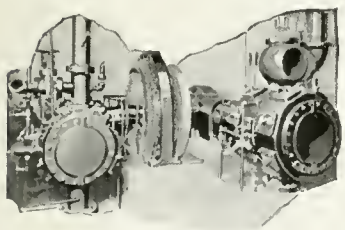


A big electrical industry uses this G-E synchronous motor for driving air compressor.

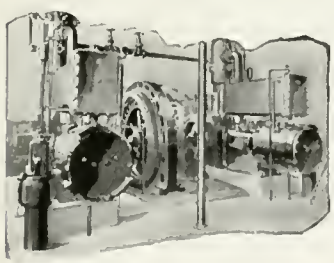


One of many installations of G-E synchronous motors driving air compressor in shipbuilding plant.

G-E synchronous motor driving air compressor in machine shop.



G-E synchronous motor driving air compressor in automobile factory.



Mining industry also uses G-E synchronous motor drive for air compressors.

G-E Synchronous Motors--- *the* Drive for Air Compressors

During the last four years 927 G-E synchronous motors aggregating 307,000 horsepower have been installed for air compressor drive the country over.

The general adoption of synchronous motors for this type of drive is an acknowledgment of the claims long made for them. In steel mills, railroad shops, shipyards, mines, automobile plants, and other important industries—many air compressors are driven by these dependable, high power factor synchronous motors.

The proved efficiency of G-E synchronous motors—practically the same from full to half load—and falling off only slightly at quarter load—makes them money savers for their users. Designed to operate at unity power factor, they improve the power factor of the system—and with a normal field excitation they continue power factor improvement when underloaded. Due to large air gap, which is five to eight times that of an induction motor, slight bearing wear does not impair the motor's operating characteristics. This is a big point where continuous operation is essential.

A G-E synchronous motor working with a standard air compressor will give uninterrupted service at low cost. Bulletin 41310 tells more about synchronous motors—our nearest office will gladly send it upon request.

General Electric Company

General Office Schenectady, N.Y.

Sales Offices in all large cities

43B-608

GARDNER

Pumps--Governors--Compressors

The ***real*** cost of any mechanical equipment is the original price ***plus the cost of repairs.*** And so we say that while the first cost of Gardner Products may be a trifle more, ***the real cost is less.***

Every day we hear of Gardner Pumps, Governors and Compressors which have been on the job for an almost unbelievable number of years, ***without any repairs.***

It would be strange indeed if 63 years of building had not taught us how to build right.

THE GARDNER GOVERNOR COMPANY
Quincy, Illinois
Pumps --- Governors --- Compressors

Chicago	New York	Philadelphia	San Francisco	Los Angeles
Fisher Bldg.	Singer Bldg.	604 Arch St.	505 Howard St.	409 E. Third St.

As a matter of reciprocal business courtesy help trace results

Talk about POWER and Strength

THE large block of granite in the dipper of the Shuveloder illustrated above was estimated, by measurement, to weigh 1500 pounds. Some load, we'll admit. But the Shuveloders are made rugged and powerful enough to load any material that the 30 inch dipper will hold. No matter if the muck is coarse or soft and wet, the Shuveloder loads it into cars faster and more economically than is possible by hand shovelers.

With the early resumption of mining operations a large amount of tunneling, drifting and cross-cutting will be necessary. For this work you will want both speed and economy. The Shuveloder will give you both.. Now is the time to investigate—let us send you some interesting data on mechanical loading, also Catalog 4-B.

LAKE SUPERIOR LOADER COMPANY

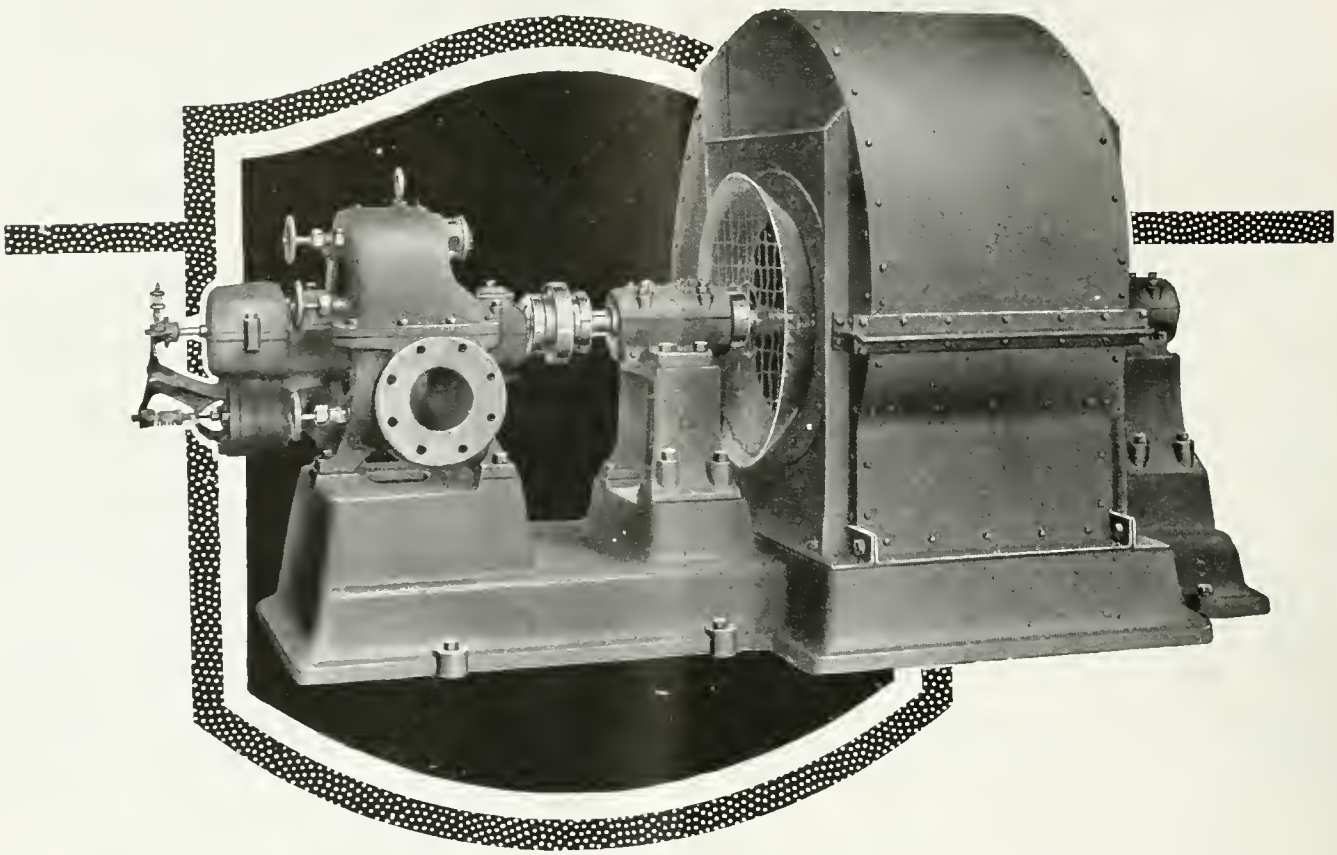
DULUTH, MINNESOTA

Western Office: Sharon Bldg., San Francisco **Eastern Office: 50 Church St., New York City**

Shuveloder

"The mechanical mucker"

for Forced or Induced Draft

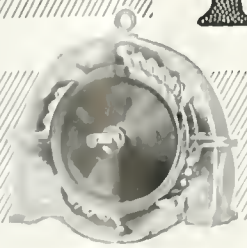


ONE of the most essential characteristics of the prime mover of a blower unit is its adaptability to speed regulation. Regulation obtained by means of throttling the air from a forced draft fan is detrimental to plant efficiency. Regulation which maintains the most efficient blower speed for a given draft requirement avoids the detrimental throttling and permits high combustion efficiency. In many installations with modern stokers Terry turbines have been controlled in this manner and have given dependable as well as economical service. This is why so many designing and operating engineers say that for best results for forced or induced draft service you should

specify

T-741

THE TERRY TURBINE



Offices in Principal Cities
in U.S.A. also in Important
Industrial Foreign Countries

The Terry Steam Turbine Co.
Terry Sq. Hartford, Conn. U.S.A.

As a matter of reciprocal business courtesy help trace results

Compressed Air Magazine

NEW YORK · LONDON · PARIS

Principal Offices:
BOWLING GREEN BUILDING,
No 11, BROADWAY,
NEW YORK.

VOL. XXVI, NO. XII

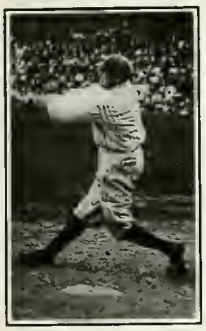
Copyright, MCMXXI,
Compressed Air Magazine Co.

DECEMBER, 1921

The Recreational Phase of a Great Industry

Contentment is the Ally of Loyalty and Good Will—the Human Factor Requires Social, Mental and Physical Diversions Promoting Team Work and Increased Efficiency

By EUGENE P. McCRORKEN



LEISURE TIME comprises one-third of modern man's existence—eight hours of each twenty-four. Furthermore, the hours of freedom have been increasing more rapidly than ever before with the adoption of daylight saving (and the eight-hour day), so that the worker and the family have a much larger amount of time for recreation than formerly.

The restoration of peace and the return of hundreds of thousands of factory workers to industrial pursuits from military service where they gained a keener sense of the benefits to be derived from physical exercise require that time and equipment should be provided for such exercise.

The proper and wholesome direction of leisure time represents today the greatest opportunity for the employment of an unexploited force in the existing social and industrial order, and in the near future all students and investigators of the industrial situation will realize that a wonderful opportunity is being and has long been overlooked.

Improvements in Social Science

Industry has been studying carefully the effect of morale upon its workers, and amateur industrial athletics, organized with the official support of the management, will do more to promote plant morale than any other single cause. A big Annual Field Day, a Thanksgiving Football Match, or a Fourth of July Baseball Game will arouse a healthful growing spirit of good will and mutual understanding between the management and men to pull together for a common end.

Men work best when they are happiest and most contented with their working conditions and environment. Scientific investigators of this subject contend that providing wholesome amusements for the people of a nation is necessary to their physical welfare and industrial efficiency. Under present strenuous living conditions every individual must have a fair proportion of relaxation and diversion. There must be periods of "play," the people must be entertained.

LEISURE time should be made an asset, not a liability. The hours spent in freedom from toil have a direct effect upon social standards and family ties and in the field of industry recreation has become an important means of conserving and increasing the spirit of content, democracy and co-operation.

The old and long accepted belief that "Business has nothing to do with Humanity" has disappeared, and industrial environment and development have now become the main influence in the social lives of those who work with hand or brain.

Important as it is to organize and direct the hours spent in industrial employment, it is equally important to provide for wholesome and revivifying amusement in the workers' leisure time.

About a decade ago a well organized movement was launched in America for the purpose of reducing accidents to mechanical workers to a minimum. So great was the success of this much needed reform that it found its way into nearly every mill, mine, and factory in the country, with almost inconceivable results. Other improvements in social science have been initiated, such as community housing, establishing industrial democracy, popular education, sanitation and welfare work, but no greater or more promising development in our complex industrial fabric has been evolved than that of providing healthful recreation to repair tired out nerves, to refresh bodily spirits, and to revivify expended energies. Realization of this important phase of industrial evolution has resulted in achieving a most desirable conservation of a national asset, the greater production of essential commodities, which in turn implies a lower cost of production and higher standards of living.

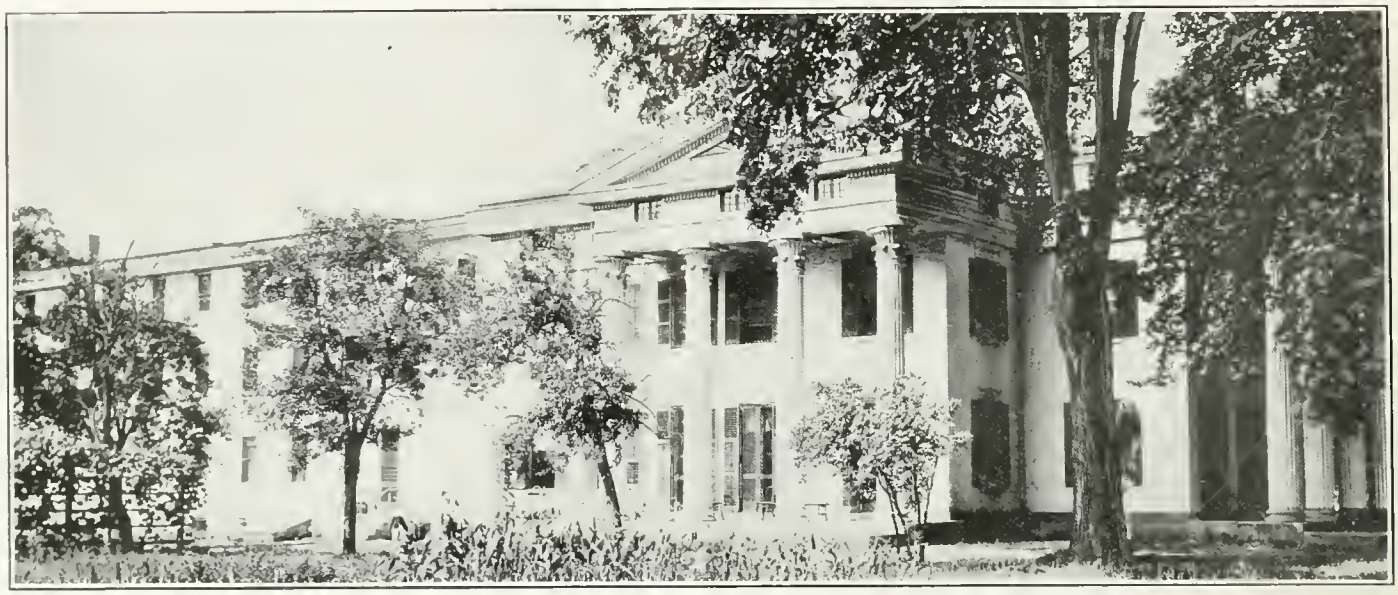
The Industrial Units Must Provide Recreational Facilities

Situated as most manufacturing plants, mills and mines are, at a distance from cities or large towns, ordinarily facilities are not such that pleasant enjoyment of idle hours can be had at a moderate cost and, providing means of furnishing the necessary relaxation of mind and body for the toiler becomes an urgent problem.

Appreciation of this lack of recreational facilities has caused the larger industrial organizations of the country, notably the United States Steel Company, The Anaconda Copper Mining Company, the American Smelting and Refining Company, and many others, well worthy of mention but too numerous to be recorded in the space here available, to organize departments to study this situation and plan measures adequately to meet the recreational requirements of thousands of employees.

Miss Ida Tarbell, the well known and gifted writer on topics concerning industrial betterment, speaking of the recreational facilities of the National Cash Register Company and the United Shoe Machinery Company, says: "Recreation breaks the intolerable monotony, probably the chief cause of the unstable payroll. What baseball is doing for health and stability in American industries cannot be

Company Club-Houses at Various Plants



Club House at Painted Post, N. Y., which is equipped with 100 bed rooms and adequate dining-room facilities.

Club House at Phillipsburg, N. J., the center of many athletic and social activities of the employees.

Club house at Athens, Pa., where a comfortable home like atmosphere adds considerably to the other social and athletic features.

Interdepartment Industrial Athletics

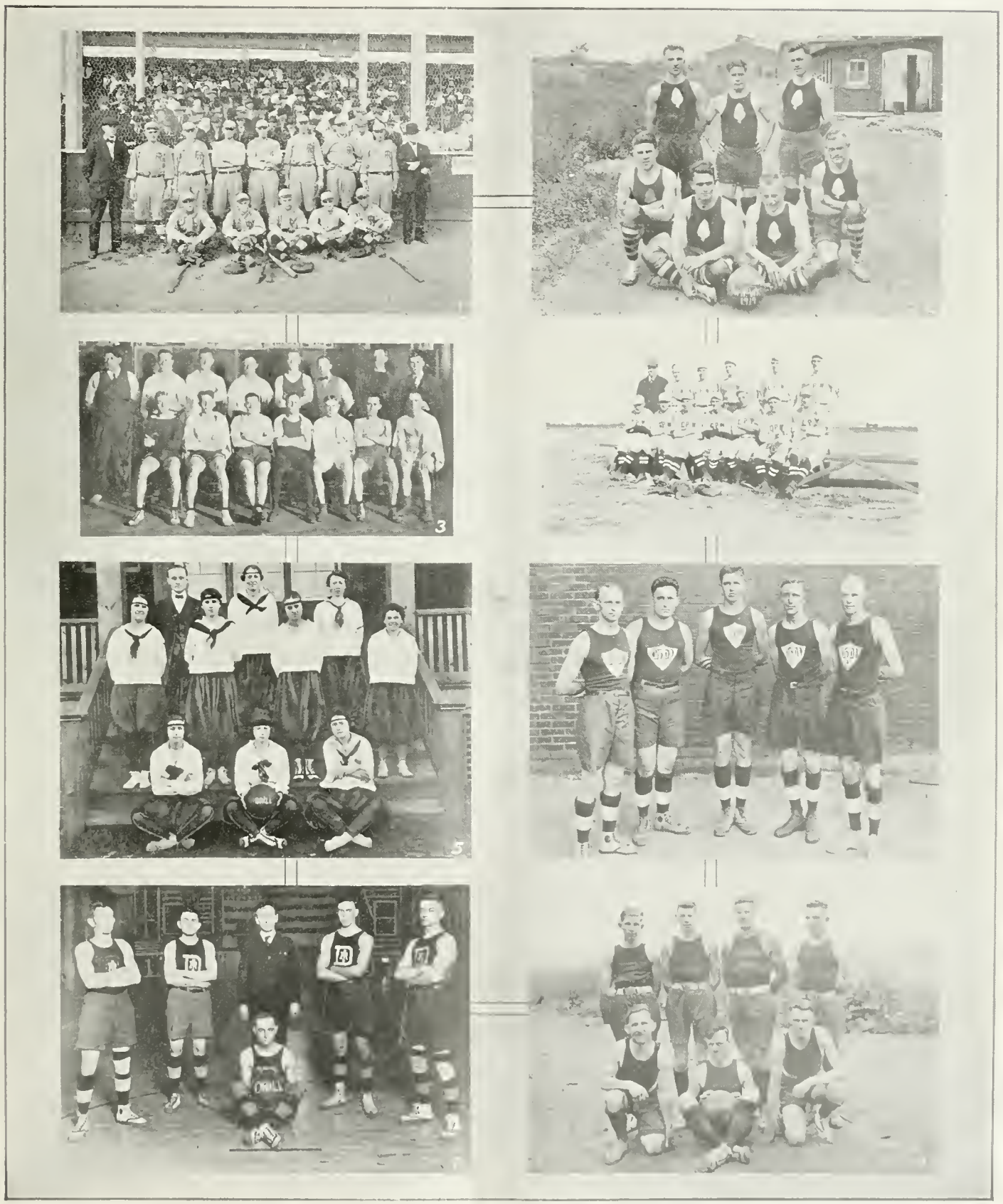


Fig. 1—Company baseball team composed of employees from Easton, Pa., and Phillipsburg, N. J., plants. Fig. 2—Basket-ball team representing the Cameron Steam Pump Works, one of the departments of the company. Fig. 3—A group of employees on the boxing squad. Fig. 4—Baseball team of the Cameron Steam Pumps Works. Fig. 5—Basekt-ball team of girl employees in the drill department. Fig. 6—Basket-ball team representing the hammer drill department. Fig. 7—Basket-ball team from the rock drill department. Fig. 8—Team representing the foundry department of the Phillipsburg plant.

The New Jersey championship shoot in which teams from all parts of the state participated. Representatives from the Phillipsburg and Easton plants of the I-R Co. were conspicuous among the competing teams for first honors.

Thanksgiving Day at the Alert-Ingersoll-Rand Gun Club showing the winners and their prizes.

A group of gunners at one of the weekly contests.

estimated." It was John D. Rockefeller who said that it was as much the duty of industry to provide equipment and facilities for leisure and play hours of its workers as it was to provide proper lighting and sanitary and pleasant surroundings during working hours.

American industries are usually divided into several classes—agriculture, mining, transportation, or manufacturing, each of which is surrounded by its own peculiar conditions, involving special problems for providing those engaged in it with healthful amusement, rest and recreation.

The purpose of this article is to describe how one concern developed recreational activities among its employees on an extensive and successful scale. The Ingersoll-Rand Company was selected as being typical of large American manufacturing enterprises. Much has been written describing advances in recreational work in the mining and agricultural districts, but manufacturing communities present special features.

Community Development at Phillipsburg, N. J.

The organization referred to numbers its employees by thousands, including executives, technical men, skilled mechanics, laborers and clerks. It operates six plants, namely those at Easton, Pa.; Phillipsburg, N. J.; Athens, Pa.; Painted Post, N. Y.; Littleton, Colo., and Sherbrooke, Canada. The Phillipsburg plant is the largest and has offered the greatest opportunity for the extensive introduction of social and athletic activities.

Phillipsburg is situated on the banks of the Delaware River just opposite the city of Easton, the site being known in early times, among the Indian tribes as the "Forks of the Delaware." No stranger ever visits this section without being charmed with the hills and valleys and winding rivers, the ever changing topography with its want of regularity or system adding greatly to its beauty.

In the west stretch the Kittatinny or endless mountains, while just below Easton where the Lehigh empties its waters into the Delaware River start the Lehigh hills stretching with a gentle curve to the west. The position of the club house on the top of a series of long sloping hills commands a view of the Delaware River rolling along through forests overhanging its banks, while across the river just opposite the club house rises College Hill upon which is located the beautiful campus of Lafayette College, surrounded by attractive and comfortable homes.

The last twenty years have brought Easton and Phillipsburg to the foreground as manufacturing centers, and their development in this respect continues while a few landmarks remain to tell us of the olden time. This is also a rich fertile country having long plateaus of land, extending to the north and south under cultivation.

Here the company engaged the services of a recreational director, Mr. William H. Anderson, a graduate of Lafayette College, where he had won distinction on the basket-ball court and baseball field, to take charge of recreational amusement and social work. The de-

Interiors of Employees' Club-Houses

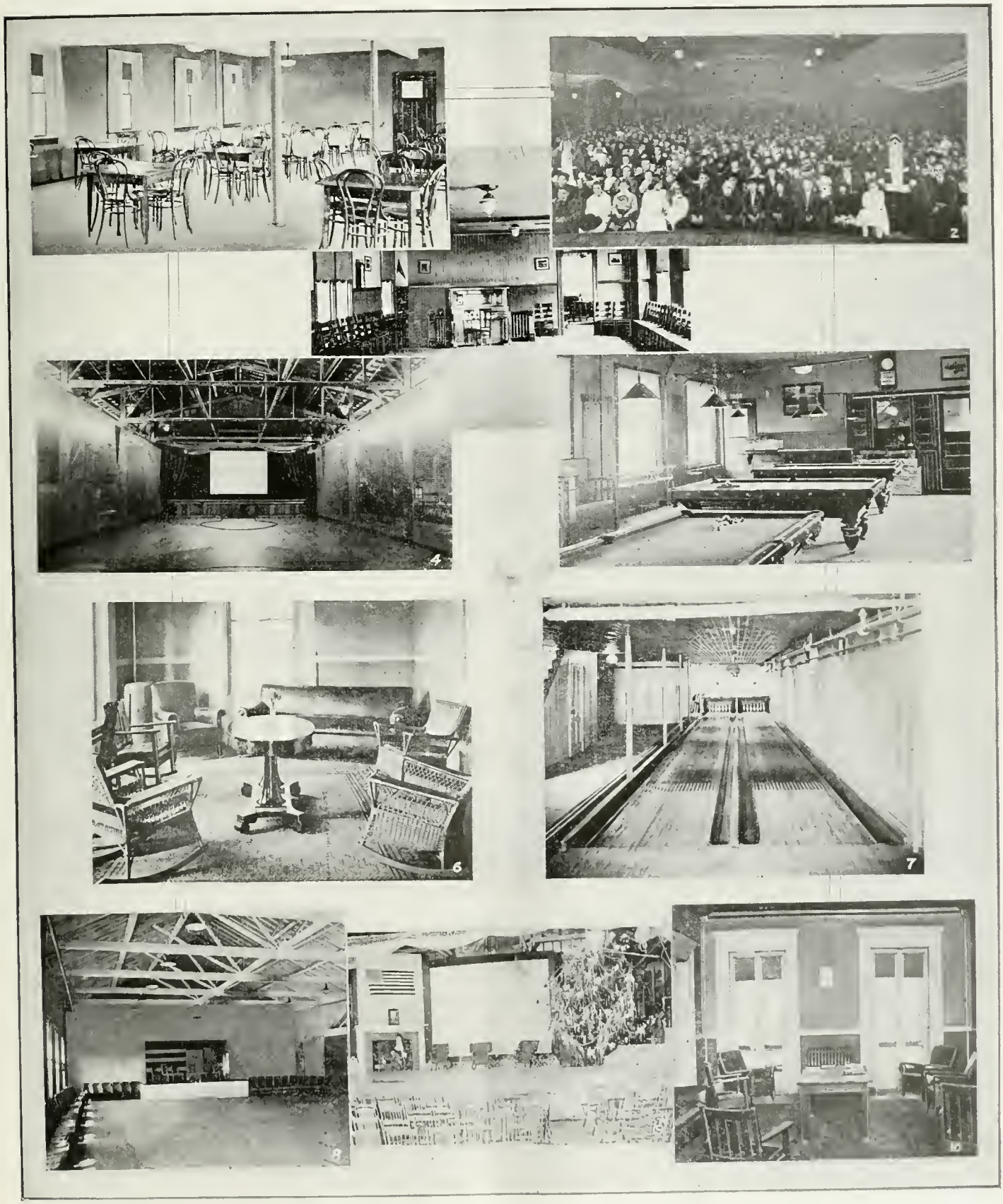


Fig. 1—Dining-room, Imperial Club-House, Painted Post, N. Y. Fig. 2—Audience at Christmas entertainment at employees' club-house, Phillipsburg, N. J. Fig. 3—Corner of reception hall, Athens, Pa. Fig. 4—Basket-ball cage on dance floor of club-house, Phillipsburg, N. J. Fig. 5—Pool room, Athens, Pa. Fig. 6—Corner of sitting-room. Fig. 7—Bowling Alleys. Fig. 8—Entertainment hall, Athens, Pa. Fig. 9—Christmas scene at the employees' club-house, Easton, Pa. Fig. 10—Corner of sitting-room, club-house, Painted Post, N. Y.

Group of employees taking a course of instruction in the manufacture of compressed air machinery. These young men spend a certain required time at various plants of the company to familiarize themselves with different manufactured products.

Tennis courts at the Painted Post plant. Note the electric lighting arrangement which allows games to continue after sundown, a very useful and convenient feature.

Children's field day on the grounds of the club-house, Phillipsburg, N. J.

velopment of this recreational work at Phillipsburg has covered practically everything in the realm of sports, including baseball, basket-ball, trap shooting, bowling, billiards, tennis, and gymnastics; also social gatherings, dances and parties held on holidays such as Hallowe'en or Christmas. Recently dramatics have been introduced, with marked success, and amateur theatricals performed by home talent constitute a veritable social safety valve for the community.

Naturally, the center of these activities is the well-appointed club house. It is conveniently located to the workers' homes and to the plant, and contains all the facilities for the indoor forms of amusement previously mentioned.

Club-House a Social Center

The club house, which is of ample proportions, has a wide porch running around nearly three sides of the building. The roof is so constructed as to permit of basket-ball games being staged there and affords also facilities for gymnastic contests. The accompanying illustrations show the exterior and interior in considerable detail. The club possesses four bowling alleys and a like number of pool tables. It has also a standard basket-ball court, and shower baths are available for both girls and men. A completely equipped gymnasium, with all kinds of complementary apparatus is provided. Facilities for indoor amusement throughout the winter months are ample and complete. Interdepartment bowling and pool tournaments are conducted under management as systematic as that of any professional organization.

The efficiency with which the interdepartment basket-ball league has been organized is apparent from the illustrations. Each department is well represented with a trained team and competition for first honors is keen. Among the men the following departments are represented: Hammer Drill, Foundry, Rock Drill, Cameron Pump and Compressor. The departments represented by girl teams are the Phillipsburg Main Office and the Easton plant. Dances held every Friday night with usually about 200 couples present are a very popular form of entertainment and one of the most generally enjoyed.

Amateur Theatricals Popular

Also, a stage has been built at one end of the hall sufficiently large to permit of any kind of theatricals being presented. At the time of my visit, rehearsals were being held for the production of "Katcha-Koo" an oriental musical extravaganza with good comedy and a tuneful musical score. The cast consisted of Hindoo, Chinese, and American characters and an ensemble of chorus and dance numbers selected to suit local conditions.

This event has now become an annual feature of the social life of the employees of the company and has proved a most diverting and delightful pastime for the players.

In previous years the show has been given to audiences numbering not less than one thousand persons on each night, and running consecutively for several performances. The cast for the present year was composed of about 100 employees, including seventeen major and minor characters with 24 in the ori-

Typical Views of the Beautiful Countryside Around Phillipsburg, N. J., and Easton, Pa.

Fig. 1—Canoeing party on the Lehigh River in vicinity of Easton, Pa. Fig. 2—On the Delaware River, which furnishes the expert canoeist with the many enjoyable thrills of the sport. Fig. 3—Bushkill Creek, scene near Easton. Fig. 4—A quiet shady spot on one of the many tributary streams of the Lehigh. Fig. 5—Picturesque winter scene near Phillipsburg. Fig. 6—A secluded spot along the Bushkill Creek, the dense overhanging foliage affording a pleasant shelter in summer months. Fig. 7—A section of the Lehigh Canal in vicinity of Phillipsburg.

A camping party on the bank of one of the many streams that enhance the natural beauty of the landscape in the neighborhood of the Easton and Phillipsburg plants.

Dispensary for Rendering First Aid to Sick or Injured

Fig. 1—Corner of a sick room in dispensary where patient may receive complete medical attention. Fig. 2—View of interior of dispensary. Fig. 3—Medical staff and building devoted to care of employees stricken during influenza epidemic. Fig. 4—Ambulance on duty at Phillipsburg plant for transfer of patients to their homes or hospital.

ental ladies' chorus, eight male priests of Buddha, thirteen young women performing veiled dances, and eight couples of society women staging a polo scene. The last act was concluded with a group of 50 children in a striking patriotic finale. A professional director is employed for a period of three weeks to train the choruses and various characters in their parts.

Altogether, these productions have been immensely popular not alone for the younger people actually engaged in the production and their friends, but the older employees and their families who attend the performances.

Numerous other entertainments are given throughout the year by professional talent, and through the efforts of the company officials from time to time prominent speakers give lectures on current events.

A section of the club-house is reserved for reading and card playing and is furnished with large comfortable chairs and lounges and victrola and piano.

Two excellent tennis courts laid out by the company are in constant use while weather conditions permit.

Ten round boxing matches are staged frequently at the club, and always bring out a large attendance. Leading heavy, middle and lightweight boxers of Allentown, Wilkes-Barre, Philadelphia, Easton, Phillipsburg, Hazelton and other centers have been matched, and some sensational bouts have been put on. In fact, not only do local celebrities participate, but boxers of much wider reputation are brought to Phillipsburg for star bouts. The evening's programme, of course, usually announces a number of the company's employees, which always adds to the interest.

Baseball and Trap Shooting Leading Outdoor Sports

The foregoing description has related to the activities of the club conducted distinctively for employees; but naturally the scope of outdoor facilities is on a considerably broader scale, particularly as regards baseball and trap shooting. Baseball, as may be expected anywhere in the United States, is the most popular of all the recreational activities stimulated by the efforts of the company. Here it has been brought to a high standard and the contests have been marked by an unusual degree of individual skill and exceptionally good team work. The employees baseball organization in common with the basket-ball club is composed of teams from each department, as well as a picked nine to represent the plant in games with outside organizations. Conducting this organization requires a considerable degree of skillful management and attention to details in order to keep the machinery in smooth running order.

The baseball organization is managed and conducted with almost the same systematic care that would be devoted to a professional league. Among the local club's opponents this year were the Philadelphia Nationals, which aggregation was brought to Phillipsburg on a substantial guarantee basis which evinces the keen enthusiasm of the company employees for the great American game and the high place it holds in the popular estimation of the community. Other distinguished visitors that performed on the diamond were the Norfolk Colored Stars from Virginia, the Subway Giants, and the Lincoln Giants.

Both indoor and outdoor athletics are popular forms of amusement among the employees, and a plentiful variety of facilities is provided to suit all individual tastes. What is probably an unusual feature among manufacturing plants is the Gun Club. It is known as the Alert-Ingersoll-Rand Trap-Shooting Association, being a combination of the earlier

club formed by members of the Alert Hook and Ladder Company and the later club formed by the Ingersoll-Rand employees.

State Championship Shoot Held at Gun Club

This club, which ranks among the foremost gun clubs of the East, has played a prominent part in the development of the sport in the State of New Jersey, and on May 12 to 15, 1920, secured the New Jersey State Championship shoot which was the most successful and largest in the history of the state organization.

The grounds are spacious, the equipment for marksmen is elaborate, and Phillipsburg is easily accessible from all parts of the state on five railroads. Phillipsburg is also situated on the Grand Trunk route and so it possesses through service from Chicago and other Western points. All of the prominent target shots of the country have displayed their skill over its traps during the last fifteen years, and in the shoot above mentioned the well-known F. S. Tomlin was high gun with the sensational score of 148 out of a possible 150. The grounds were furnished by the Ingersoll-Rand Company and practically all of the officers of the plant are members, including Mr. Geo. R. Elder, vice-president of the company, who is now serving his second term as president of the Gun Club. The success of the Gun Club is due in considerable measure to Mr. Elder's enthusiasm and love of the sport, which inspired his continued efforts in the interest of the association. In 1919 there were 76,000 targets shot over the ground and in 1920, 122,000 targets. Every Saturday afternoon throughout the year and on all important holidays a shoot is held.

No mention has been made of the Athens, Painted Post or other plants of the company. At Athens, where the pneumatic tools are manufactured by the company, the recreational facilities includes a club-house, tennis courts, baseball diamond, picnic grounds, and other outdoor equipment for athletic games and an amusement hall for large indoors gatherings. The club-house is equipped with bowling alleys, pool tables, dance hall, reading rooms and an up-to-date cafeteria. The reading and lounging rooms are equipped with comfortable divans, easy chairs, rugs and pictures and a home-like atmosphere pervades throughout. The club has a private dining-room and a number of guest rooms are always in readiness for visitors.

The amusement hall used in conjunction with the club house, owing to the comparative smallness of the club hall to take care of the large number of couples that attend the dances, is one of the most up-to-date stadium buildings. With its 6,000 square feet of floor space it affords ample opportunity for dancing, basket-ball, indoor baseball, wrestling and boxing bouts. A band of twenty pieces composed of employees furnishes music for every occasion. There are also provided cloak rooms, lockers and shower baths. A stage has been installed at one end of this building where theatrical entertainments are conducted on a large scale with unusual success. Recently it has been the custom to hold a fair which continues for three evenings in the winter months. Booths of all description line the walls with their particular barkers who try to outdo the band in the general hubbub so absolutely necessary at a fair. Local talent supplies the vaudeville and a dance concludes each evening's entertainment.

A baseball park has been laid out within recent years with an excellent diamond and a grandstand. The baseball field is flooded over in winter for use as a skating rink. At important baseball games a parade is formed and headed by the band leads the crowds to the ball grounds. After the game the grounds are converted into a park for picknickers who consume the sandwiches and soft drinks. In the evening a display of fireworks, another parade of a fantastic character, followed by a dance, concludes a sufficiently strenuous day. On such occasions while these activities are in progress, it is necessary in Athens to have special traffic officers, one way streets, and special auto parking spaces.

Mansion Remodeled into "Imperial Club"

The plant at Painted Post is situated in the northern section of New York State, well known to the tourist for its charming and wonderful scenery. The rolling character of the country covered here and there with heavily wooded areas is greatly enhanced by the numerous mountain streams and running brooks. Ideal picnic grounds and camping sites are within easy distance of the plant.

Within ten minutes' walk from the shops, there is a large colonial mansion surrounded by about twenty acres of beautiful grounds. This is called the "Imperial Club," and in 1912 was given to the employees by Mrs. Henry Lang of Montclair, N. J., one of the stockholders of the Ingersoll-Rand Company. The gift was made by Mrs. Lang in memory of her brother, Jasper Rand, now deceased, who, as a young graduate just out of Cornell, was employed at the old Imperial Engine Works, the beginning of the present plant, which has since expanded to the large proportions required by the growth of the compressed air machinery industry.

Immediately after the gift was made known, the interior of the former mansion was renovated and redecorated by the company

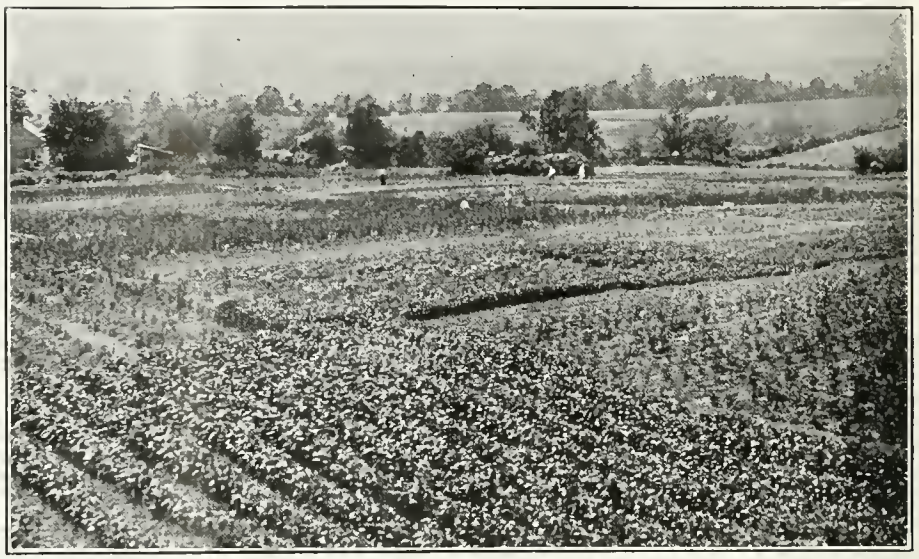
One of the weekly baseball games during the season on the Painted Post grounds between the Ingersoll-Rand team and opponents representing an outside industrial organization. These games have developed the keenest rivalry among the employees of a large group of manufacturing plants.

throughout and made modern in every detail. Alterations were made to provide facilities for employees who desired to make their home at the club. The grounds about the club were cleared and made more beautiful by landscape gardeners.

Part of the estate was set aside as a baseball park and an athletic field, and another part was divided into a set of tennis courts. A good-sized orchard is found on the grounds where fresh fruit may be had when in season. A large space is set aside for a garden that insures a constant supply when in season of fresh vegetables for the table, which supply never fails in its appeal to the appetite of the visitor.

With the rapid growth of the shops and the increasing popularity of the club, it soon became apparent that additions to the original buildings would be necessary. A three-story fireproof brick-and-steel structure was erected to the rear of, but directly adjoining the original building. The lower floor of the new addition is devoted to a spacious dining-room, and the two upper floors are used entirely as dormitories and shower baths, in addition to those already in the original building.

The Imperial Club is run for the benefit of the employees on a cost basis, and living conditions are made thoroughly enjoyable and home-like. The dining-room is an important adjunct in adding to the general sociability. The usual restaurant atmosphere is entirely absent, the room possessing many advantages and services made possible by the splendid appointments of the club. This makes it exceptionally convenient for employees staying at the club and for those who live at a distance from the plant, as it is possible for them to obtain good, substantial and well-balanced meals, prepared under the personal supervision of a competent cook and served promptly. This service is open to all employees, regardless of whether they hold membership in the club or not. Providing employees with a warm and wholesome meal at a low cost, thereby removes the tendency of many workers to economize in this way to the detriment of their health, strength and efficiency. It is the general testimony that this and the other restaurants established at the various plants of the company are used and appreciated because the quality of the food, being rigidly supervised by those in charge, in conjunction with the best kind of home cooking, makes these meals a potent influence in maintaining the general health of the workers.



A section of a plot under cultivation by employees. These plots are divided into individual lots and in the recent period of high cost of living aided greatly in providing a complete supply of fresh vegetables for the worker and his family.

Membership in the club is held strictly to employees at the plant, and though the membership fees are only a nominal amount, the privileges afforded the members are many and attractive. Mr. Cavanaugh, the resident manager, is responsible for the upkeep of the buildings and grounds, as well as for the many social and athletic activities.

Early in the spring of the year the Imperial baseball team, composed of employees at the Painted Post plant, trains and practices every evening for the coming season. During the baseball season games are held every week with teams from nearby cities and towns. A first-class squad of ball players for years has been developed in Ingersoll-Rand uniforms, and a number of the players have been drafted to the major leagues. The grandstand alone will accommodate three thousand baseball fans, while as many more have often been seen on the bleachers.

On the opposite side of the club-house from the ball park are the tennis courts, the scene of many hotly contested series during the summer months. Tennis rivalry among the employees is exceptionally keen, the season starting during the latter part of May or early in June with a preliminary tournament, and lasting through until late in September, winding up in a series of tournaments with other clubs. In many of these tournaments the home teams have been victorious.

Among the many other apointments of the club are a large and completely equipped pool and billiard room, a reading room having all the technical and popular magazines on file, a music room and lounging room. There are also parlors and rest rooms for the women employees.

Community Dances Winter Features at Club

During the winter months, many formal and informal dances and social entertainments are held at the Imperial Club. On these occasions the entire lower floor is thrown open to the guests, the dining hall is cleared, and with the already highly polished floors and a few appropriate decorations, the building becomes one of the most attractive community centers possible.

The foregoing pages have been devoted to describing the social and athletic activities engaged in by the company's employees, but closely allied to this kind of work are other activities among employees of a more practical nature and yet providing in sufficient measure, recreation and relaxation.

Agricultural Advantages

One feature of much benefit has been the allotting of ground to individual employees for vegetable gardens. About five years ago the company introduced this practice and allotted considerable land surrounding the plants and the plan has proved a decided success. The land was plowed by the company, and the individual gave it only ordinary care to obtain a supply of fresh vegetables for the family table.

At Phillipsburg during the war and in recent

Results obtained by one employee farmer.

periods of high prices, the company plowed and fertilized 20 plots of land and divided each plot into lots, 50 x 100 ft., which were allotted to any employee making application. The services of an expert from the Pennsylvania State College of Agriculture were obtained to supervise the planting, weeding and otherwise caring for the crops. The result surpassed all expectations as on each lot more than sufficient vegetables of all kinds were raised for the worker's family.

A Country Fair was held in the Phillipsburg Club House showing exhibits of the products of the various plots and afterward awarding prizes. One Italian exhibitor had raised on his lot, 1,500 tomato plants during the season. On one occasion during the period of high prices a potato syndicate, so called, was formed among a group of employees to raise a crop of potatoes on land furnished free by the company. The company financed the planting and raising of the crop and then pro-rated the expense among the members, deducting the amount from the pay check, and also apportioned the quantity of produce raised to each individual. The result was that each bushel received by a member cost him $2.00, whereas at that time potatoes cost from $4.00 to $4.50 per bushel in the open market.

Easton Technical Society

There has been organized at Easton a technical society among the employees of the company who are to become the future sales representatives, engineers, or to be employed in other departments. Meeting rooms are provided that possess many excellent advantages and are popular as is indicated by their constant use. Members find the society rooms a convenient place to get together and talk things over. All the latest trade and popular journals are kept on file with reference books on mining, railroading, shipping, construction work and various other fields of engineering. Engineers from the main office in New York and different plants as well as the branch managers explain on regular meeting nights the manufacture and application of the products in detail, and just before the close of the meeting the subject under discussion is thrown open for general debate so that the most possible benefit may accrue to those attending. These meetings while conducted strictly on a parliamentary basis are really informal and any individual is permitted to ask questions or state his views. A great deal of enthusiasm has been aroused by discussions of actual conditions encountered in the ordinary routine of a branch office. The members are acquainted with the different steps in actually executing a sale, and in making a satisfactory installation.

There is a regular sales course of instruction for young technical graduates and others to familiarize them with the use of compressed air in the fields of industry. This training requires 65 weeks, during which time the young engineers work in the shops making parts, assembling them, and finally turning out the completed machine. Written examinations are held at certain periods to discover the candidate's fitness. The questions are of a most practical nature which a sales engineer would run up against in the course of a day's work. I was permitted to glance over the examination on the subject of drills and rock drilling and was quickly convinced of the thoroughness and utility of the course of instruction.

A candidate before he graduates will be entirely familiar with all the conditions encountered in the drilling of a Pike's Peak granite, and be equally well informed on the resistance offered by a quartz porphyry in a Colorado mining district to a drill bit or in other words, he will be able to intelligently recommend the proper equipment for any actual drilling work met with or to be performed. The heat treatment of steel, a matter of the utmost importance in the manufacture of this kind of machinery, is emphasized by great attention to the details of the process both in theory and practice.

The grape-arbor at the Imperial Club Painted Post, N. Y. Sufficient supplies of fresh fruits in season were here obtained for the club-house table.

Company Stores Run on Cost Basis

Under this department, general stores are operated on a cost basis. These stores sell general merchandise, including boots, shoes, overalls, underwear, candy, gloves, electric light bulbs and numerous other articles of everyday use. Potatoes, sugar, coffee and all kinds of canned goods are sold on a wholesale basis to individuals. This arrangement has been found of much value to the community and results in considerable saving to the employees.

Hospital Dispensary Equipped by Company

Dispensaries where first aid may be rendered are established at the plants and have all the modern equipment for treating the sick or injured. At Phillipsburg a number of bedrooms are provided for patients requiring immediate rest, while a trained nurse and hospital orderly are in constant attendance. Cases of a serious nature are transferred to the municipal hospital, or if the individual desires, his or her family physician may take charge in the patient's own home.

Several company automobiles make it convenient for the nurses to visit the patients who are thus confined to their homes. The dis-

A picturesque section of the Lehigh River near Easton, showing the heavily wooded hills and valleys characteristic of the surrounding countryside.

Fertil farming land outside the city limits of Phillipsburg and Easton.

persary also maintains an ambulance to facilitate the removal of any person to the hospital.

At the time of the influenza epidemic in the autumn of 1918 which carried off more lives in America than the casualties of the recent war, and which closed many schools and theaters, the various plants of this company were suddenly confronted with a problem that could not be solved with existing hospital facilities. Hundreds of employees, the heads and members of families were stricken down and records show that over one thousand in the various plants were absent from duty at one time. In this emergency the club houses were turned into emergency hospitals to care for the more serious cases and the buildings were centers for directing general relief measures in their vicinity.

Results of this Work of the Highest Constructive Value

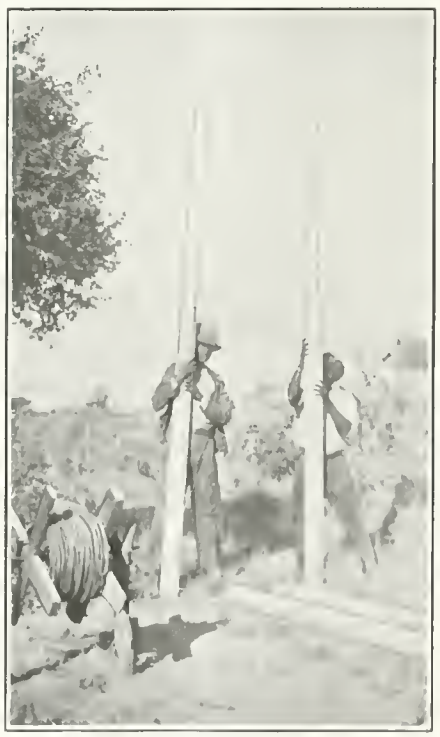
The work along the lines described in the preceding pages possesses the highest constructive value as is evidenced by the flocking of the population of suburban and isolated districts in large numbers to the big industrial centers, where facilities for recreation are many and diverse. In many small manufacturing districts existence means only an endless routine of work and sleep and provides no attraction for young or old. The employment of the leisure time of our armies of employees should not be left to mere chance nor wholly to the employees own resources and ingenuity but their play time as well as work time should be carefully organized and placed under supervision.

The difference between an enthusiastic, energetic, alert minded worker and an unconcerned, lethargic employee in a large number of cases is merely a matter of recreation. There is nothing that attaches so productive of the spirit of loyalty so much desired by large and small industrial companies as departmental athletics. Play quickens the mental processes, encourages the perfection of health through proper exercise and provides complete relaxation from thought of business or shop so beneficial to working people.

Among the wide range of subjects to be considered by the metropolitan branch of the Society of Automotive Engineers during the winter are chassis lubrication, power absorption from the fly wheel to the road car performance and how to obtain a definite factor of safety in it and traffic problems, including that of parking space.

SOUTH AFRICAN ROCK CORES

A DRILLING outfit in South Africa, Southwest Protectorate, furnishes the accompanying illustration, showing some very fine cores they have been taking out. The cores illustrated are 5/8 inches in diameter and the material is a pure blue granite of great hardness and density.



Cores of pure blue granite drilled out of solid rock by a core drilling machine in South Africa. The cores shown are about six inches in diameter

An E-1 Calyx core drill is doing the work and the operators report some very satisfactory results. This type of drilling machine, it will be remembered, uses chilled shot instead of diamonds to obtain the cutting action. The illustration does indeed give evidence that some almost perfect cores are lifted out of the ground with this class of core drill.

One of the most promising copper deposits ever discovered in this country, it is reported, has recently been unearthed on the west coast of Newfoundland. The full extent of the lode is said to be of a very high percentage. Development work has already commenced.

AUTOMATIC SEPARATION OF NITROGEN

A body of hot nitrogen gas in one of the lead-silver mines in Utah is reported by Mr. G. E. McElroy of the Bureau of Mines. It is considered to be a residual atmosphere, due to the abstraction of oxygen from air through the rapid oxidation of sulphides. The resulting nearly pure nitrogen gas (the samples analyzed ran over 99½ per cent nitrogen), being lighter than air, accumulates in the top of raises and stopes, with a level sharp line of separation from the mine air below. The gas had a temperature of 175 deg. F., though the air three feet below was only 120 deg. F., and at one foot below, 135 deg. A candle or acetylene light raised into the gas is extinguished; and the gas, of course, cannot be breathed.

FOR DETECTING CARBON MONOXIDE

C. R. Hoover, of Wesleyan University, gives an account in the *Jour. Ind. Eng. Chem.* (1921, xiii, 770) of the use of a new reagent, Hoolamite, which consists of fuming sulphuric acid and iodine pentoxide, mixed with an inert supporting material, according to the *Journal of Franklin Institute*. This reagent was the subject of a patent by Messrs. A. B. Lamb and C. R. Hoover, from which presumably the uncouth name is derived. The inert material used is pumice. The reaction is the conversion of the reagent into a green mass, the depth of color being mainly proportional to the concentration of the carbon monoxide in the gas tested. Two portable devices are described by which tests may be made away from the laboratory and an approximate quantitative measurement made. It has been found that one of these devices is sufficiently sensitive to detect in a few seconds carbon monoxide in proportions believed to be harmless to human beings or the larger animals. The use of the instruments is not difficult, and it is hoped that very soon further improvements will be made in the preparation of the reagent and the operation of the apparatus.

The U. S. Bureau of Mines is conducting an investigation in the Nevada gold mining fields of the use of gunite in metal mines. The possibility of the cement gun being used in the preventing or minimizing of rock burst in deep metal mines is being given especial attention.

Great Lakes-St. Lawrence Tidewater Channel

Trade Route From the World Ports to the Midland of North America, the Principal Source of Iron and Grain, the Foundation of Commerce and Manufactures

By WILLIAM L. SAUNDERS*

THE WORLD'S greatest producing area is geographically in the midland region of North America about the Great Lakes. This area, with but one-third of the nation's population, produces, with the exception of tobacco and cotton, three-quarters of the principal staples. It provides the surplus or export grain, meats, dairy products, steel and leading minerals.

The social and political condition of a nation is determined by its industrial efficiency, and the share of the commerce of the world obtained by a nation is fixed more by the economy of its transportation than by any other factor. It is an economic maxim that—The total cost is the cost of production plus transportation cost.

The cost of carrying 1,000 tons by water or 100 tons by rail is equal over the same distance.

The main source of production for foreign trade is the region economically tributary to the Great Lakes; it produces, of our surplus wheat, 75 per cent.; corn, 65 per cent.; flax, 100 per cent.; iron, 85 per cent.; copper, 39 per cent; zinc, 74 per cent.; lead, 46 per cent., and 50 per cent. of potatoes and sugar beets, and contains 40 per cent. of the value of manufactures, 50 per cent. of the cattle and 70 per cent. of the measured coal reserve.

The natural economic outlet to world commerce of this stupendous production, available for export, is the St. Lawrence River. The waters of the Great Lakes find outlet to the sea down the valley of the St. Lawrence, in a volume sufficient, at a moderate current speed, for a channel of one mile in width and 40 feet deep—a cross section that would permit of the passage of 50 Lusitanias abreast.

The geographical position of this great waterway and the condition of its internationalism will be contributary aids to the augmentation of trade with the nation now purchasing the major part of our surplus products. The distance from the head of lake navigation to the present head of ocean navigation approximates 1,250 miles; 95 per cent. of this distance is in international waters. Our trade with Canada approaches the aggregate of commerce with the rest of the Western Hemisphere and the Pacific, and our trade with Great Britain is greater than our traffic with any other nation.

The international development of a Great Lakes-St. Lawrence River steamship channel, to afford free passage way to the larger modern ocean going freighters, will reduce the cost of transportation from the head of lake navigation to Liverpool, the world's grain port, to a charge less than that now obtaining for carriage from the same lake port, via rail or canal, to the hold of any vessel in port on the Atlantic seaboard of the United States.

It is estimated that the saving in freight rates would be equivalent annually to the cost of the development to the United States. The income from hydraulic power, made available in the carrying out of the project, would more than pay the fixed charges for interest and sinking fund of a bond issue in sufficient amount to defray the cost of the waterway and structures. It is a 100 per cent. investment.

The West demands a direct and economical outlet to the sea for its immense surplus production. To forward the realization of its purpose the Great Lakes-St. Lawrence Tidewater Association has been organized, a voluntary association of the fifteen member states of Illinois, Indiana, Ohio, Michigan, Wisconsin, Minnesota, Iowa, North Dakota, South Dakota, Idaho, Montana, Wyoming, Colorado, Nebraska and Missouri.

The Dominion of Canada is now undertaking the first and most important step toward an adequate outlet to the Atlantic for the enormous and ever-increasing export production of the region tributary to the shipping of the Great Lakes.

The greatest natural obstruction on the route to the sea is the difference in elevation of Lake Erie and Lake Ontario at Niagara Falls. The great engineering feat of building a canal from lake to lake is rapidly progressing toward completion and but for delay due to war conditions, it would now be in operation.

With the opening of this canal (the New Welland) the foot of lake navigation will have been advanced from Buffalo 220 miles toward the sea to Ogdensburg or Prescott—but 120 miles from the head of ocean navigation and access to the seaports of the world.

The locks of the Welland Canal are of a size to pass a vessel 800 feet long, with a draft of 30 feet. An example of the larger lake vessels is the Canadian S. S. *W. Grant Mordan* 625 ft. long, 59 ft. beam and 33 ft.

*Reprinted with additions from "Mining and Metallurgy."

Courtesy, Canadian Pacific R. R.

Dock shoal forming natural dam of Lachine Rapids. Vessel in comparatively quiet water above shoal about to enter chute.

© Underwood & Underwood.

Typical view of wide reaches of St. Lawrence River.

deep; this vessel has carried in single loads, 760,000 bushels of oats, 476,000 bushels of wheat, and 14,000 tons of coal—the cargo of a fleet of fourteen 1000-ton canal barges.

An international commission has been established representing Canada and the United States and the engineers have prepared their estimates and recommendations relating to an international waterway of 25 ft depth, and of 30-ft. depth, from the foot of Lake Ontario to ocean navigation at Montreal. The estimated cost of the 30 ft. channel way is about $270,000,000; this cost includes the installation of a hydro-electric plant at the Longue Saulte Rapids of 1,464,000 horse power. The annual operating cost of the whole, depreciation included, is estimated to be $2,562,000. The operating cost of power only $1,457,000.

From the head of lake navigation to Liverpool, via transfer to rail or barge canal at Buffalo, is about 5,000 miles; from the same lake port by way of the St. Lawrence River and Gulf to Liverpool is 4,550 miles or a lesser distance of 450 miles.

The greater distance is due to the divergence from the direction of destination at Buffalo—the transfer point where cargo is transferred to canal barge or rail for New York. The New York State Barge Canal and connections is 479 miles to New York; by the shorter rail route the distance is 396 miles.

The freight rates on wheat over this route are in the following proportion:

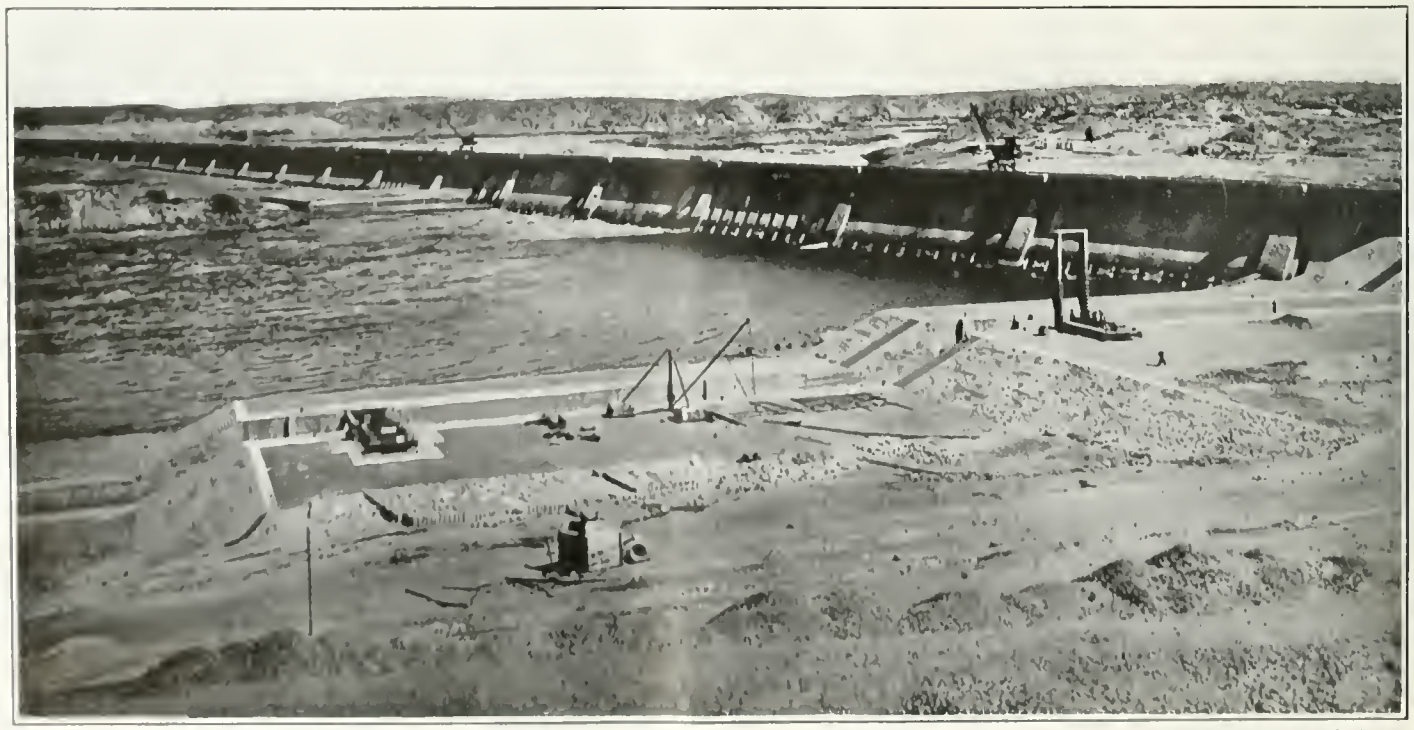
	Cents a bushel
Duluth—Buffalo (in elevator)	2.5
Buffalo—New York (on barges)	6.5
New York—Liverpool	5.
	14

Over 46 per cent of this cost is entailed in the transfer from the original lading and the increased haul, of about ten per cent, away from the direction of the destination of cargo.

Through carriage in large modern freighters from the port of embarkation to the port of discharge would avoid the onerous delays and unnecessary costs of a longer haul, the loss entailed in transfer of cargo from the original lading on to smaller vessels or cars, port and terminal charges, and the uncertainty of time of delivery usual in the haulage of freight through long, tortuous canal systems. These restraints on commerce would be eliminated in the proposed direct route down the valley of the St. Lawrence.

It is estimated that 40 per cent of the present cost of transporting bulk cargo from the Great Lakes for foreign export may be saved to the producer by replacing the present indirect restrictive method of transportation by direct and uninterrupted carriage of freight from the port of loading to destination. These conditions will obtain through the development of the Great Lakes-St. Lawrence project, and the restrictive economic bounty now exacted from the producer by the prevailing methods will be removed.

From the head of the first rapid on the St. Lawrence (the Galops) to connection with ocean navigation is 116 miles; the difference in elevation or drop over this distance is 220 feet.



© Underwood & Underwood.

The Assuan dam on the River Nile, Egypt, one of the greatest engineering feats of the age, showing locks and canal in the foreground.

The aggregate drop is made up of the combined heights of the natural dams, in the form of rock schoals which cause the rapids.

The rapids of the St. Lawrence have been given an exaggerated reputation for turbulence and danger—in the romantic legends of the earliest voyageurs who navigated the river in canoes and through the efforts of modern publicity agents for excursion boats that "shoot the rapids."

The average current of the rapids is probably less than twelve miles an hour and the combined length of all rough water in the rapids is probably less than eight miles. The length of all the canals is about 45 miles. These canals are of a length to pass those parts of the river where the resistance of the current is too great for the efficient operation of tow boats and barges. The length of the present canals is therefore much greater than the length of the rapids. From Prescott to Montreal, about 120 miles, down traffic does not pass through the three upper canals but takes advantage of the river channel and its current for about 35 miles. From this point to Montreal there are 33 miles of canal with sixteen lockages, and clear river and lake for 52 miles. A cargo vessel of 2,500 tons under her own steam can make the down trip of 120 miles from Prescott to Montreal in a day.

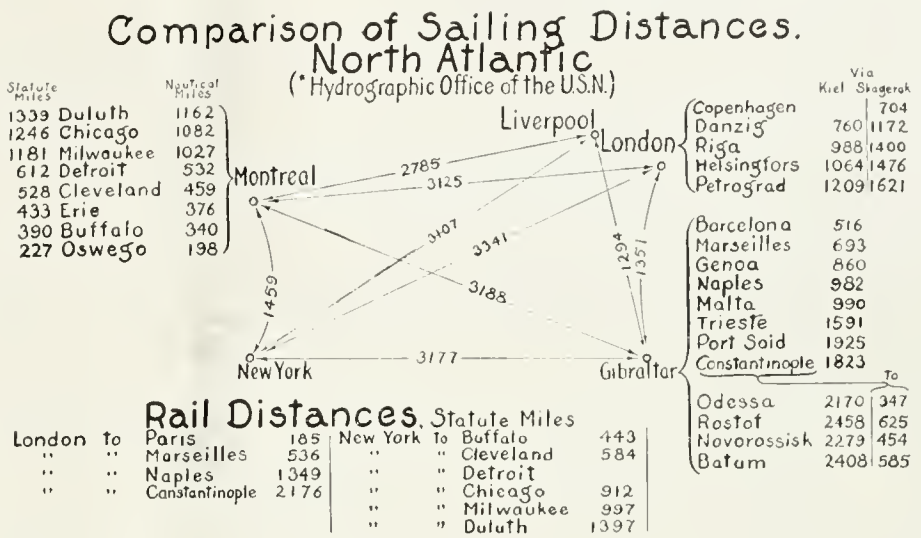
The nation's manufacturing industries produced values of almost 63 billions of dollars in the decade 1910-20—three times the total of 1910 and five times the aggregate of 1900.

A billion bushels of wheat is about the quantity that is raised in this country each year. Half of this, because of the cheapness of transportation, goes down the lakes to Buffalo. This fifteen millions of tons is here unloaded into barges or cars and practically all goes by rail. This burden, superimposed on the already overburdened railways, paralyzes traffic and embargo ensues.

Half of a billion bushels would equal the cargoes of two thousand ships, each of 250,000 bushels, or the lading of more than 700,000 cars of 700 bushels each—about 17,500 train loads of 40 cars each.

Practically all export grain goes to Great Britain or Scandinavian ports; the direct, short, quickest and cheapest route is down the St. Lawrence River, without either transfer delays or charges.

The lake freighters provide the cheapest means of transportation in the world; their charge per ton mile is .07 cents as compared to one cent by rail. Economical and efficient transportation lies at the foundation of industrial development and commercial supremacy.



The value of the lake vessels is over $200,000,000, and they carry more than 100,000,000 tons each season.

The bringing together of the cheap coal of Pennsylvania and the cheap and rich iron of the Mesabi range has been made commercially practicable by the cheapness of water transportation. The ore production exceeds 50,000,000 tons yearly.

Cheap water transportation and not the iron is the foundation of the position of the United States as the world's greatest producer of iron and steel.

Wheat and iron, because of their essential nature, and their fundamental position in the trade and commerce of the world have been used to illustrate, in part, the tremendous movement in transportation, production and manufacture in the region of the Great Lakes. The Census Bureau shows that the value of our manufactures has tripled in the last ten years. There is no reason to believe that the proportionate increase will not continue in the main area of production—the great manufacturing and producing realm surrounding the Great Lakes, save and except by reason of lack or want of adequate means of transport and outlet for the vast logical increment in manufactures and produce.

The Welland Canal, when completed, will provide passage for steamships from Lake Erie and Lake Ontario. With the opening of this canal deep water lake navigation will have been extended to a point less than 125 miles from the head of ocean navigation.

This short section, about five per cent. of the distance from Duluth to the Atlantic, is the barrier to half of the population of North America, to the realization of the benefits from the most economical and efficient means of transporting their commodities to the markets of the world.

A broad conception of the topography of the St. Lawrence over this section of 125 miles suggests a series of three steps, of low lift and great depth, representing the rise from the head of ocean navigation to Lake Ontario: the first rise being the Lachine Rapids to the level of Lake St. Louis, the second the rise to Lake St. Francis, and the third rise to the level of Lake Ontario.

This conception can be actualized to meet all the requirements of deep water navigation by the construction of dams and locks.

In Egypt, three and one-half miles above Assuan at the beginning of the cataract or rapids, a masonry dam, 150 feet high from its lowest foundations, stretches one and one-quarter miles across the Nile. The waters impounded by the dam form a vast lake 200 miles long. Locks on the western side of the dam provide passageway for navigation between the upper and lower reaches. The flow of the Nile at flood is 350,000 cubic feet per second; sluiceways control the great volume of this discharge.

The flow of the St. Lawrence is but 241,000 cubic feet per second; it is proposed to raise the water levels in the reaches of the river by a series of dams, similar to that at Assuan, but of much lesser dimensions.

Route of proposed international waterway from Lake Ontario to head of ocean navigation.

TAKING INDICATOR DIAGRAMS

*By P. A. BAUMEISTER**

MUCH HAS BEEN written on the subject of indicator diagrams and many diagrams have been published, but the men who can take really good cards are few and far between. The reason is simple enough—an indicator is a delicate mechanism requiring careful handling in order to get results. The average engineer takes only a few diagrams at rare intervals and therefore is not familiar enough with his apparatus to take the necessary precautions to get satisfactory results. It is the intention of this article to point out the requirements and necessary steps for getting good indicator diagrams.

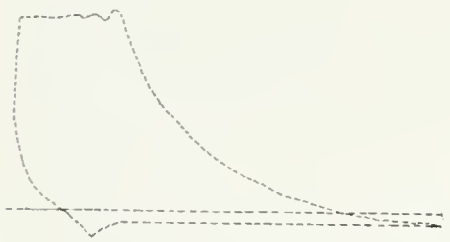


Fig. 1.—Diagram lines a series of fine points.

In order to understand the problem it will be well to consider what an indicator diagram really is. Its name defines it. It is a diagram indicating, for any position of the piston, the pressure existing in the cylinder at the particular time when the piston is in the given position. In practice it is impossible to place the indicator in the cylinder and, therefore, it becomes necessary to have a pipe, port or connection leading from the cylinder to the indicator. This introduces the first source of possible error. This passage should be as short as possible with few turns and a clear opening. The air, steam or gas in the passage leading from the cylinder to the indicator piston is a compressible fluid and does not respond instantly to changes in pressure. That is, there is a time lag introduced here which is reduced to a minimum by keeping the passage as short as possible. In practice this means an indicator at each end of a double-acting cylinder. The ordinary manifold and three-way cock is not suitable when accurate diagrams are desired, although it may be good enough for ordinary valve-setting diagrams.

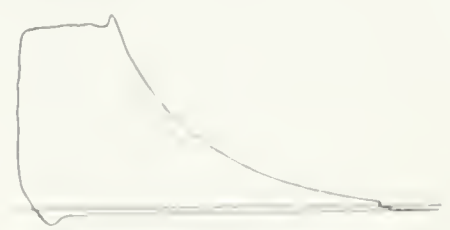


Fig. 2.—Loop at beginning of compression line indicates indicator lag.

There is little to be said as to the indicator itself as any good make can be used with success. The preferred is for the outside spring type with a real lead point. Metallic points can be used but because of the greater pressure required on the point to trace the diagram, there is more friction set up between the pencil and the paper, with the result that it is not so sensitive to slight changes in pressure. A well-sharpened lead lightly pressed against the drum giving a fine line obtains the best results. When properly set, this line is not continuous but is a series of fine points, as shown by Fig. 1, thus giving a minimum of friction between the point and the paper.

The indicator piston should be well oiled and free in its cylinder. When the spring is disconnected the weight of the pencil arm should be sufficient to move the piston in its cylinder. If this is not the case it is probably because of dirt or rust on the piston, causing it to bind. If it does bind it should be carefully cleaned, touched up with fine emery cloth, if necessary, and oiled.

All play between the indicator piston and pencil motion should be eliminated, as play at this point causes the pencil point to lag behind the indicator piston. This play is shown on the indicator diagram by a horizontal line. For example, consider the compression stroke of a compressor where the pressure is constantly changing; if, at the beginning of the stroke, the diagram looks like Fig. 2, it indicates either a loose indicator piston or play in the motion. The pressure is constantly increasing and the indicator piston is rising but the pencil point fails to move, causing the horizontal line. When the play is all taken up there is a sudden movement of the pencil point which does not record the true pressure changes taking place in the cylinder.

Either before or after use indicator springs should be calibrated. This can be done by connecting the indicator on a gage-tester and drawing horizontal lines for various pressures; see Fig. 3. By scaling these lines and comparing with the weights on the tester the true scale of the indicator spring can be determined.

Fig. 3.—Lines for checking indicator springs with gage tester.

Indicators are generally driven by a cord, which should be of the best possible quality, well stretched. The drum on the indicator tends to lag behind the cord when being accelerated and to over-travel toward the end of the stroke. To overcome this as much as possible and reduce the stretch of the cord, the drum tension should be as great as possible. Connecting two or more indicators on the same driving cord helps in this respect.

Weak drum springs or cord stretch is shown on the diagram by a horizontal line. For example, take a compressor diagram and consider the reexpansion line. If it looks like Fig. 4, it indicates weak drum springs or stretching cord.

In most case indicators are driven from the crosshead of the machine to be indicated, an arm being attached for this purpose. This arm should be as short and stiff as possible in order to reduce its tendency to vibrate. Last but not least is to see that diagrams are taken simultaneously at all points to be indicated and at frequent enough intervals to get average results. Cards should be marked with all the information possible—speed of machine, size, spring scale, gage reading, etc., so that they are as complete a record as possible. Other minor thoughts will occur to the operator, such as blowing out all connections to eliminate any pipe scale, condensed steam, etc.

Fig. 4.—Indicating a weak spring or a stretching cord.

If the reader will stop and consider that it is just little things as pointed out briefly here that mean the difference between just diagrams and real indicator diagrams and give a little thought to analyzing them, he will find that he can obtain good diagrams from which much can be learned.

*Reprinted from Power.

OIL SHALE DEPOSITS IN THE ROCKIES

Recent investigations made by the United States Geological Survey show that there are enormous quantities of oil shales which can be made to yield hydrocarbon oils to a much greater extent than we can hope to obtain from our oil wells. The oil shales of this country contain considerable quantities of oil, but it will be necessary to invest a large amount of money before the oil shale industry is of any commercial importance. There are no commercial oil shale plants operating in this country at the present time, but there is a well established industry in Scotland, according to the report, and it has been found that many American shale deposits are richer in recoverable oil than Scotch shales now being worked. The oil shale industry cannot hope to supplant the petroleum industry but will probably grow up from local industries in favorable places.

NATIVE PLATINUM FOUND

It is reported that native platinum has been found in a winze started in the workings 500 feet from the surface in the Drum Lummon mine on the northern coast of Canada. The Drum Lummon mine is a gold property in the Skeena district, half way between Hartley Bay and Kitimat. It is located one mile from the beach, and a mill, which was started two years ago, is being developed and added to. With improvements now contemplating it will have a capacity of 100 tons a day.

The American consul reports that a contract covering the purchase of additional equipment for the large cotton-spinning mill at Mukden, China, was recently placed with an American firm. The new contract covering the purchase of an additional 10,000 spindles and 100 looms, as well as the purchase of a 1,000-kilowatt turbine power plant, represents an expenditure of approximately $620,000.

Early History of Gold and Diamond Mining in South Africa

By C. A. LAGESEN, M. P. C.

GOLD WAS first discovered on Moodies Mountains near the town of Barberton, Transvaal, in 1875, by Messrs. Hilton & Barber. The gold was found in blue quartz running in schist, with country rock of granite, gneiss and quartzite. From this date gold mining was developed in South Africa with great energy. Rich strikes were made, such as Moodies, French Bob, Fortuna, United Ivy, Barretts and the Sheba, which was the richest of all. When the Sheba Gold Mining Company was floated, the $4.00 shares went to $400 apiece. This company is still working. The town of Barberton was laid out and very soon became a lively mining camp, people streaming in from all parts of South Africa and other parts of the world upon hearing of the phenomenal richness of the strikes made. Wild speculations followed and fortunes were quickly made and lost.

At the same time gold was discovered in Kaapsche Hoop, known as "Devil's Kantoor." This name was given it, owing to its inaccessibility, the gold being found on the top of a mountain 6,000 feet in height, with no roads whatsoever. When a rough road was ultimately completed, it was so steep that it took 36 oxen to drag up a wagon; on coming down, it was necessary to fasten all four wheels with chains.

All the gold found there was mostly placer or alluvial. Reefs also were found, but proved unpayable. A town was laid out on top of the mountain called Kaapsche Hoop; it is still in existence, a little alluvial still being worked.

The prospectors soon streamed out of Barberton to prospect the country, with the result that gold was discovered in the Komati Valley, about 40 miles from Barberton. The township of Steinsdorp was laid out and several mines were started such as Virginia, Comstock, and Sheba Queen, but owing to the patchy nature of the quartzite reef, all these companies were a failure. All that remains to-day is the town of Barberton with about 5,000 inhabitants and half a dozen properties working. No doubt the payable properties with good reef are still awaiting investors in this district, especially in these days of modern mining machinery methods.

In 1886 gold was discovered at Witwatersrand (now Johannesburg) and the first light ten-stamp battery was erected by Mr. Strubens. This gold was being won from what we to-day call the North Reef, and the battery was erected at the water two miles from the reef, the ore being conveyed to the battery by Scotch carts. Simultaneously, gold in the Banket-Reef of the Rand was discovered by Mr. Bantjes at a place afterwards known as the Pioneer Gold Mining Company. After this it was soon discovered that the banket formation extended for miles on the strike of the reef, and mine after mine was opened up and floated into companies such as the Pioneer, Bonanza, Robinson, Ferreira Langlaagte, City and Suburban, George Goch and many others. The township of Johannesburg, from being a mining camp under canvas and a few huts in Ferreira, grew as if by magic into a town of brick and mortar and well laid out streets. Speculation was rife, money plentiful, and townships were laid out around the center of Johannesburg, such as Fordsburg, Jeppestown, Doornfontein, Braamfontein and City and Suburban, in a very short while. The stands (plots 50 by 50 feet and 50 by 100 feet) were put up for auction and sold in Fordsburg for $20.00 apiece; these same stands within six months changed hands at $2,000 apiece. Plots in the central part of Johannesburg, which were sold for $200 were, within a short period sold for $10,000 to $20,000 each. These plots are to-day worth $250,000 each and over.

A peculiar feature of the strike of gold was that where it was first opened it was the richest part of the 60 mile reef, such mines as the Pioneer, Bonanza, Robinson and Ferreira, being the richest mines on the Rand. The Transvaal at that time was a republic under President Kruger, with an able executive council consisting of men like Burger, Cronje, Kock, Joubert and Pretorius. These men were all Voortrekkers (pioneers) or sons of Voortrekkers, having gone up with the great pioneer movement into the North, being dissatisfied with British rule in the Colony and Natal. They subdued the wild native races and clearing the country from lions and other wild animals started their own republic known as the Transvaal Republic. The leaders of the Boers, lion-hearted men of able brains, but with very little world knowledge or education, soon found that with the discovery and opening up of the rich gold fields, many classes of people were flocking from all parts of the world to the Transvaal. As the years went by and more mines of great wealth were opened up, a movement was started by the leading Uitlanders (foreigners) and an Uitlander community was formed in Johannesburg in 1895, which was in close communication with Mr. Cecil Rhodes, the diamond magnate, and empire builder as he was called. This committee, organized the Jameson raid, the leader of which was Dr. Jameson, Mr. Rhodes' physician and trusted friend. He, with a company of 600 men invaded the Transvaal from the North, namely from Rhodesia. It had been arranged that at the same time the Uitlanders in Johannesburg should rise and overthrow the Transvaal Republic, in favor of England. This plot, however, was doomed to failure, as the Boers knew all of their plans.

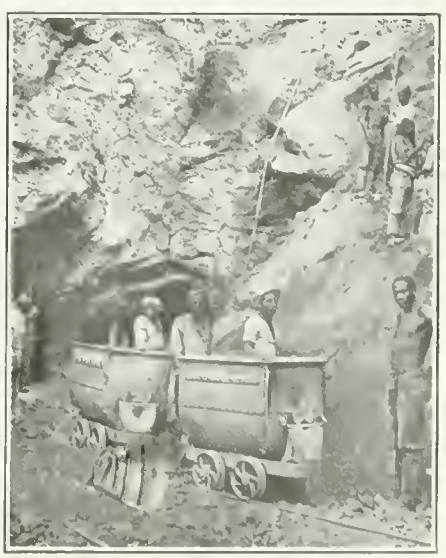
Jameson was cornered at Doornikop, fifteen miles from Johannesburg and there taken prisoner with all his men. He was sent to England, through the leniency of President Kruger, there to receive punishment from his own government. He was sentenced to two years imprisonment, of which he served only two

© Underwood & Underwood.

Way down in Village Deep gold mine workers ready to charge up.

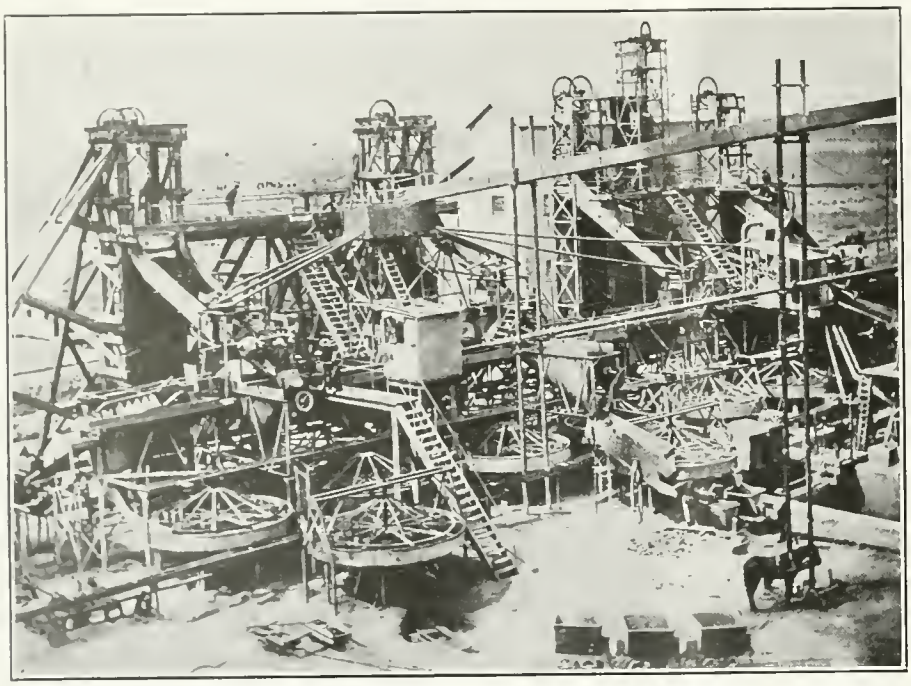
© Underwood & Underwood.

Largest hole, De Beers diamond mine, Kimberley, showing pipe where diamonds occur in the matrix.

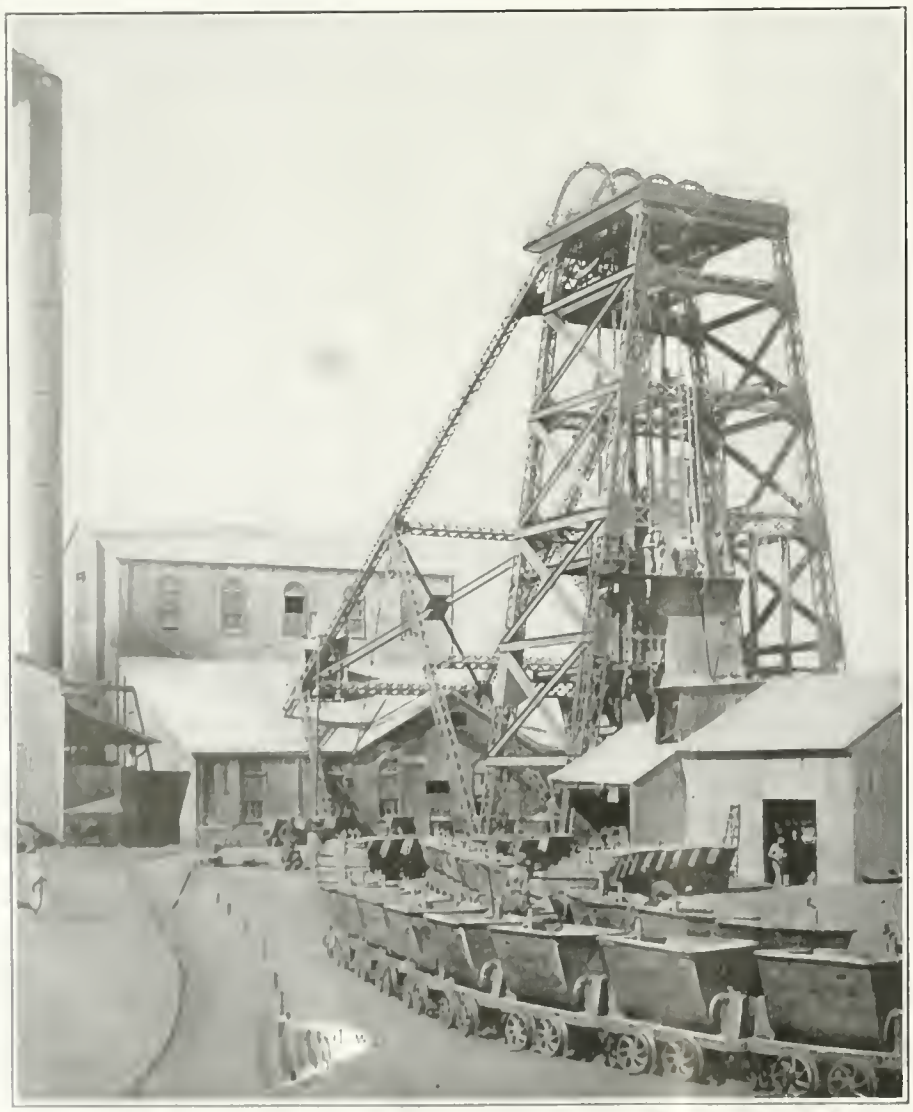


© Underwood & Underwood.

Kaffirs at work in one of the big De Beers diamond shafts at Kimberley, South Africa.



The De Beers Consolidated Mines Co., Ltd., is the largest diamond mining company in the world, controlling about 80 per cent of the entire diamond output. The mines of the company are De Beers, Kimberley, Dutoitspan and Bultfontein, comprising about 33,568 acres.



© Underwood & Underwood.

Hoisting plant and headframe of Kimberley diamond mines. The deepest shaft at the Kimberley mine in 1920, was 3699 ft.

months in Brixton prison, London. His ultimate reward was to become Premier of the Cape Colony and he was knighted by the King of England and made Sir Starr Jameson.

After this attempt the Uitlanders kept on agitating until the final breaking out of the Boer war, which resulted in the annexation by England of the Transvaal Republic.

The gold mining industry on the Main Reef went ahead with, leaps and bounds, both east and west of Johannesburg, the Bantjes, Roodepoort, Champs D'or, and Randfontein Estates on the West Rand, and the East Rand Van Rhyn, Van Rhyn Deeps, Modder, and Modder Deeps, State Mine and Springs Mines, were opened on the East Rand.

As mining advanced, modern machinery was installed and modern methods were introduced in mining. The rock drill, especially the Leyner type played a very important part in lowering costs. The writer remembers and compares the heavy cumbersome drills, worked by himself in the Robinson gold mine in 1892, with the up-to-date drill of today, which with its great efficiency and lightness has revolutionized mining. Besides, of late years electric hoists and electric pumps have been installed.

The South African Government still owns some very desirable land on the East Rand which has the main reef underlying and many rich mines will yet be opened up. Besides the South Africa has many rich gold fields in other districts, such as Murchison Range, Laidenburg and Barberton waiting to be developed.

South Africa is, therefore, the coming country with its vast mineral wealth, its huge agricultural possibilities and industries. The country is very lightly taxed in comparison with any other country at the present day. It has a small white population of 1¾ million, and about eight million natives. The national debt is $700,000,000, of which $520,000,000 is covered by the value of railways and harbors.

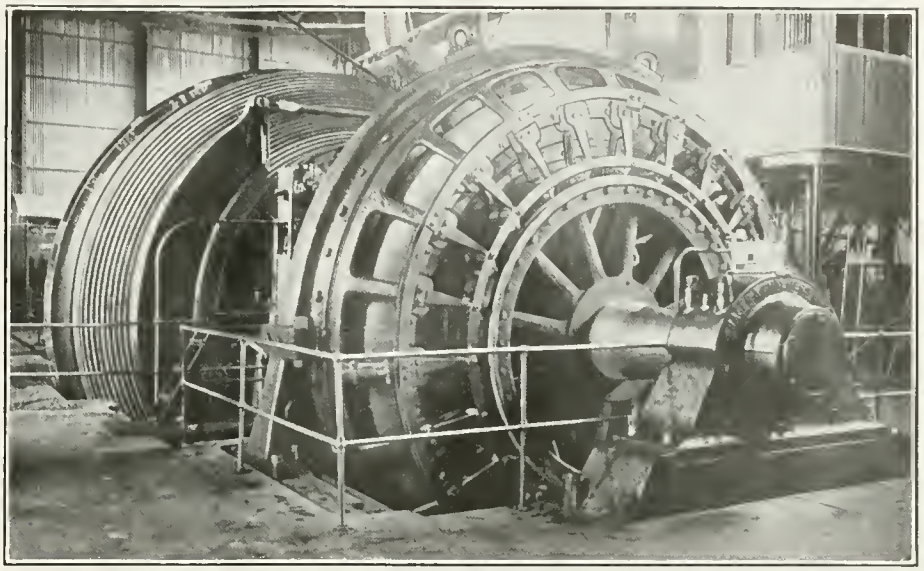
The Diamond Mine Industry of South Africa

The rapid progress of South Africa may also be said to have commenced with the discovery of the first diamond in 1867, which momentous event was due to the chance find of a beautiful diamond by a native who had no idea that it was a diamond and deposited it, with a small collection of other pretty pebbles found near the Orange River, in the Orange Free State. The stone having later on been identified as a diamond, led to the search for others by farmers of the district, and prospectors who found their way to that distant part of the country. The gravels of the Orange River contain many pretty agates, chalcedonies, etc., and the same class of pebbles being found in the Vaal River led a number of prospectors to search its terraces, for the previous gem with marked success.

This led to the prospecting of the adjacent veldt, for the source of the diamonds, and in 1869 the Bultfontein Mine was discovered. Fol-

lowing quickly on this came the discovery of the Dutoitspan, Kimberley and De Beer's Mines. The town of Kimberley named after Lord Kimberley, then Colonial Secretary in London, was established around the Kimberley Mine. About twenty years later the fifth great mine of the group known as the Wesselton Mine was found. By this time the industry was on a sound basis owing to the amalgamation of the diamond mines by Mr. Cecil Rhodes. Prior to this great achievement the diamond market had been in a most unstable condition for want of suitable control, and only the richest portions of the Kimberley and De Beer's Mines were making profits. The numerous Dutoitspan and Bultfontein claim-holding companies, failed one after another until they were all at a stand-still. Then came the control and fostering of the diamond production by De Beer's company, which gradually influenced a rise in the price of the precious gem. This happened after Dutoitspan and Bultfontein had been purchased by Rhodes from the owners, the London and South African Exploration Company, Ltd., and from that time the price of diamonds has steadily advanced for the benefit not only of De Beer's Company, but of South Africa as a whole. From an output of 200 carats, valued at $1,000 in 1867-68, the annual production rapidly increased until in 1919 the total output of diamonds in the Union of South Africa reached over $72,000,000 in value. During the 50 years since the first diamond was picked up on the Orange River, many diamond mines have been found in South Africa, but only about twenty have proved to be more or less payable. Of these, about half established themselves, as permanently payable propositions, while the remainder has only succeeded in repaying capital outlay.

The greatest group of diamond mines is the Kimberley Group, consisting of Dutoitspan, Wesselton, Bultfontein and Kimberley. The latter is the smallest and richest of the group and likewise the deepest, having been mined over 3,500 feet below the surface. The open workings form the deepest artificially made, open hole in the world, being considerably over 1,000 feet deep. De Beer's Consolidated Mining Company has made a profit of $300,000,000 from its diamond mines in addition to acquiring great landed, mining and industrial enterprises of various descriptions. To secure this wealth some 30 tons of diamonds have been won. The pulverization of the blue ground on the floor, out on the veldt, was the first necessary step in the treatment of the hard diamondiferous rock, on account of the washing methods in vogue. This consisted of treatment in rotary pans, which required the ground to be thoroughly disintegrated and mixed with water to form a muddy puddle in the machine. During the pulverization process the blue ground crumbles to pieces, and thereby releases the diamonds and other heavy minerals from their matrix. During the washing process the diamonds and associated minerals such as garnets, limonite, olivine, etc., are separated from the lighter particles in the pans and eventually tapped which completes the process of winning nearly every diamond the blue ground contains. To-day the rotary pan which necessitated the flooring of the blue ground, is being entirely replaced by jigs, on arrival at the surface. This direct treatment consists of crushing and jigging, thereby saving the company's interest on its capital outlay for flooring blueground, and also minimizes the thefts of diamonds.



Engineering & Mining Journal.

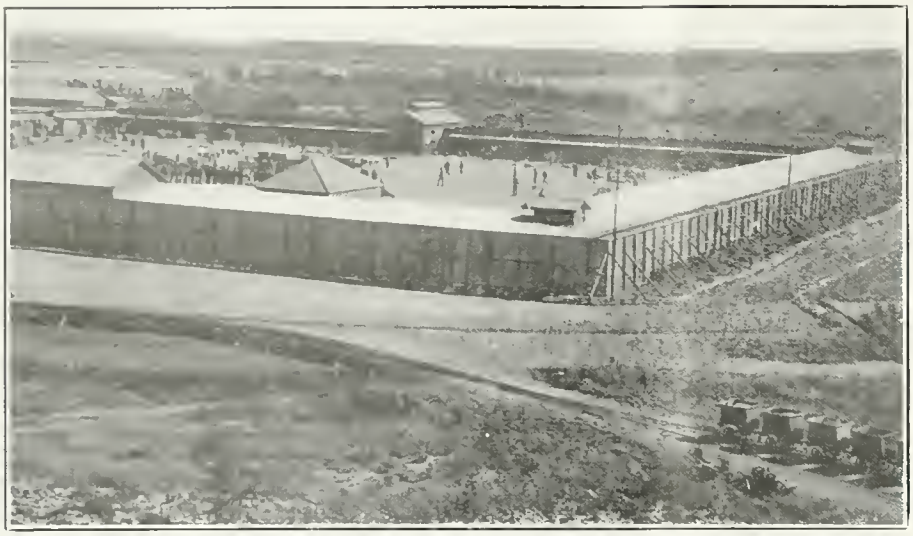
An electric hoist in the Crown mines, Johannesburg. This company is probably the largest gold producer in the world. Immense mining and reduction plants, capable of treating practically 8,000 tons of ore daily have been installed by this company. In the equipment are 835 stamp, 26 tube mills, and sand and slime plants.

The successful mining methods of De Beer's Company and the great profits which have accrued indirectly stimulated prospecting operations throughout South Africa, leading to discoveries not only of other diamond mines but of gold, tin, copper and other metals and great areas of coal. It was found that diamond mines were not confined to certain formations, known as Karroo shales, around Kimberley and the Orange Free State, where the Jagersfontein, Koffyfontein, and Voorspoed mines were located, but that they occur practically in every other formation in South Africa. The discovery of a small diamond mine near Pretoria, led a few years later to the opening of the Great Premier Mine, by far the largest of the South African pipes. This mine is 3,500 claims in extent. It has produced by far the largest diamond in the world, known as "The Cullinan," weighing 3025 carats, or 1.37 pounds. It is one of the biggest holes in the world made by man and is the result of employing nearly 12,000 native workmen, extracting per day of 24 hours, 40,000 loads of ground.

The great success and size of the Premier Mine spurred the diamond prospectors of South Africa to further effort, which in the

© Brown Bros.

Sorting the gravel for diamonds at Kimberley, South Africa.



© Underwood & Underwood.

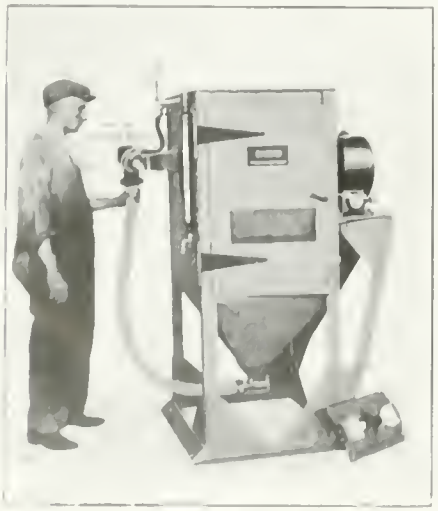
Typical compound wherein natives are housed during employment at the mine.

years following resulted in discoveries of the diamond in other parts of the Transvaal, Rhodesia, Griqualand West and German Southwest; then further northwards to the Congo Free State where alluvial diamonds were located. Fortunately for the diamond industry of South Africa about 90 per cent. of the diamond discoveries has proved to be unpayable, and as much of the country has been thoroughly prospected, it is becoming exceedingly difficult and expensive to locate new payable mines.

If the future should fail to produce even one more diamond mine, South Africa would still be able to supply the world's greatest demands for this beautiful gem, for the mines which have already yielded 185,000,000 carats of diamonds, valued and sold for $1,400,000,000, still contains hundreds of millions of dollars in diamond bearing blue ground awaiting the miner with his drill and dynamite.

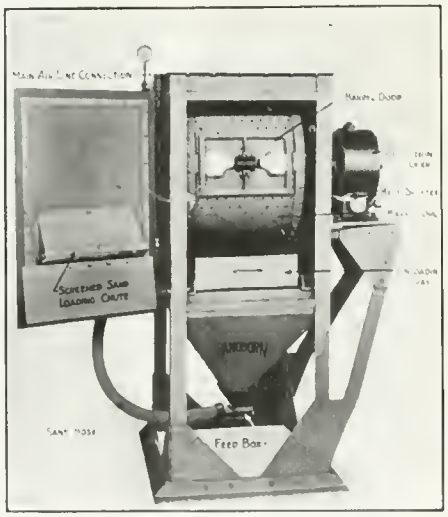
A NEW SAND-BLAST BARREL

A SAND-BLAST outfit to handle economically the numerous small parts that are constantly being ground, machined, heat treated, galvanized or otherwise worked or treated has been placed on the market by the Pangborn Corporation, Hagerstown, Md.



New Pangborn sand blast barrel

It occupies small space, is entirely self-contained, has continuous feed, uses small volume of air and the initial cost is so low that it is available to any plant. The device consists of a sheet metal, dust tight cabinet or housing, on a structural steel frame, the bottom being



Sand blast barrel with door open showing interior mechanism.

hopper shape to receive the abrasive, and equipped with a feed box to which is attached a hose that conveys the sand to the nozzle.

The barrel drum, mounted within this cabinet or housing is 24 in. diameter by 16 in. long, and is constructed of perforated sheet metal, mounted on a shaft at one end, supported in bearings of large size. This shaft is equipped with a gear, engaging a worm (in reduction) on the main driving shaft, which is equipped with tight and loose pulleys and belt shifts. The entire driving mechanism is contained in a cast housing, all outside the cabinet or barrel housing, being integral with the structural frame.

The interior of the barrel drum is fitted with baffles which turn the load as it rotates slowly, bringing all pieces and all faces under the blast action. The spent abrasive drops through the perforations of the drum, into a screen tote box beneath the drum and through into the hopper for reuse. The tote box receives the load when the barrel is dumped.

The sand-blast occupies a floor space of 2 ft. 7 in. by 3 ft. 6 in. by 5 ft. 6 in. high.

AN ELECTRO-PNEUMATIC SIGNAL SYSTEM

THE BOSTON Elevated Railway has installed a new electro-pneumatic interlocking plant with alternating-current control. The machine, described in the *Railway Signal Engineer*, is so designed that a total of 159 functions is controlled from seventy-four working levers, requiring a space of seventeen feet three inches. The principal features of the interlocking installation include semi-automatic control of all main track signals, automatic stops at all signals governing movements in normal direction of traffic on the main tracks, section locking, sectional route locking, approach locking for all main line signals governing entrance of trains into interlocking, illuminated track diagrams, light indicators on all switch levers to show whether the track section in which the switch is located is occupied or unoccupied, and an intercommunicating system between the various signal towers.

TESTS OF PAINT SPRAYING

The results of careful tests of the work of paint spraying by compressed air have been published recently in *The Architect*, London. It was shown that spraying requires approximately ten per cent more paint than brushing when the surface being treated is an iron roof, while brushing requires approximately 200 per cent more labor than spraying. On exterior brick walls spraying requires seven per cent more paint than brushing, while brushing requires 109 per cent more labor than spraying. On interior ceilings and walls of plaster spraying requires 40 per cent more paint than brushing, but gives a better hiding in one coat. On similar work brushing requires 160 per cent more labor than spraying, and gives a poorer hiding in one coat. Although it has not been possible as yet to arrive at a definite conclusion confirming the relative durability of spraying as compared with hand painting, it is claimed that the investigations so far made tend to support the belief that the spraying work will last longer.

JUST AS GOOD FOR AIR PIPE

WELDING a steam line approximately one mile in length was successfully accomplished at the plant of the Dayton Lighting Co., Dayton, Ohio. The line is constructed of ten, twelve and fourteen-inch pipe and carried a pressure of about 200 pounds. During construction the line was frequently tested with cold water at a hydraulic pressure of from 400 to 500 pounds, and when steam was turned into the line it was found tight in every joint. The electric welding process was used.

Although the blue diamond is considered by many the rarest gem, pink and black diamonds, if perfect, command a still higher price in the market. Green and red diamonds have also been found, although on rare occasions.

The Making of Blown and Pressed Glass

A Branch of the Industry That Manufactures Great Quantities of Glassware For Table and Lighting Purpose—Uses of Compressed Air in Various Difficult Operations

By ROBERT G. SKERRETT

PRESSED AND BLOWN glass constitute nearly 25 per cent of the output of America's glass factories, and in the course of a single year this department of the industry turns out products to the value of more than $30,000,000. The commodities include tableware, tumblers and goblets, lamps, chimneys, lantern globes, lighting goods of divers sorts, stem ware, opal ware, cut ware, and various kinds of decorated glassware. Manifestly, an industry of this nature and magnitude contributes to the comfort and convenience, not to mention the pleasure, of a decidedly large proportion of the populace.

The art of making pressed tableware is of native origin, and dates back to 1827, when a carpenter of Sandwich, Massachusetts, one Deming Jarves, made the first pressed tumbler. Prior to that time, it seems that all glassware that was not cast was fashioned by blowing. Jarves' discovery revolutionized the industry, for it greatly reduced the cost of production and made it feasible to manufacture immense quantities of the same article. Indeed, with growing skill, it was found practicable thus to imitate the finer ware. At the start, however, the shaping of glass by means of molds and presses was employed only for the commoner grade of goods.

By the close of the "sixties," goblets and wine glasses were produced by the pressed method and were then well-nigh as fine and delicate as those made by the older procedure of blowing and cutting. We shall see presently, as might be expected with the march of mechanical progress, that compressed air came, in its turn, to supplement or even to supplant the human lungs, as has been the case in other branches of this great industry.

Previously to 1864, pressed-glass articles of the better classes were fashioned of flint glass.

THE MAKING of blown and pressed class for tableware, lighting fixtures, and miscellaneous purposes is an important phase of the glass industry in this country, where glass of all sorts is used more widely and in larger quantities than anywhere else in the world.

This particular division of the glassmaker's art illustrates more strikingly than the rest of the industry what might be termed the ancient and the modern practices of the craft. Herein, as elsewhere evidenced in the manufacture of glass, we see how compressed air is rendering it practicable to speed up production, to effect economies, and to turn out the while better grades of commodities.

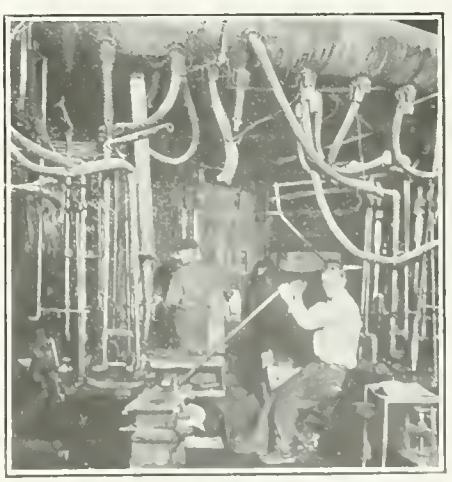
That is to say, the batch was composed of the best sand obtainable, pearl ash, refined saltpeter, and oxide of lead. Cheap tumblers and other common ware were then produced from a mixture of soda ash, lime, nitrate of soda, and sand. But in 1864, William Leighton, of Wheeling, West Virginia, succeeded in making a clear, brilliant glass, later known as lime-flint glass, which nearly extinguished the old flint-glass industry and gave a tremendous impetus to the pressed-glass business. Leighton's batch consisted of bicarbonate of soda, pure sand, lime, and nitrate of soda; and its cost was only about one-third that of the lead-flint batch.

And now for that branch of the trade that concerns itself with the making of so-called lighting goods. The records disclose that between 1850 and 1860 the glass industry contended with a great depression; but a notable improvement followed the adoption of coal oil and then petroleum as illuminants. The wider use of the oil lamp at once stimulated the flint-glass trade through the increasing demand for lamp chimneys. The general introduction of gas and later the advent of electrical illumination led glass manufacturers, around 1885, to begin the production of modern lighting goods.

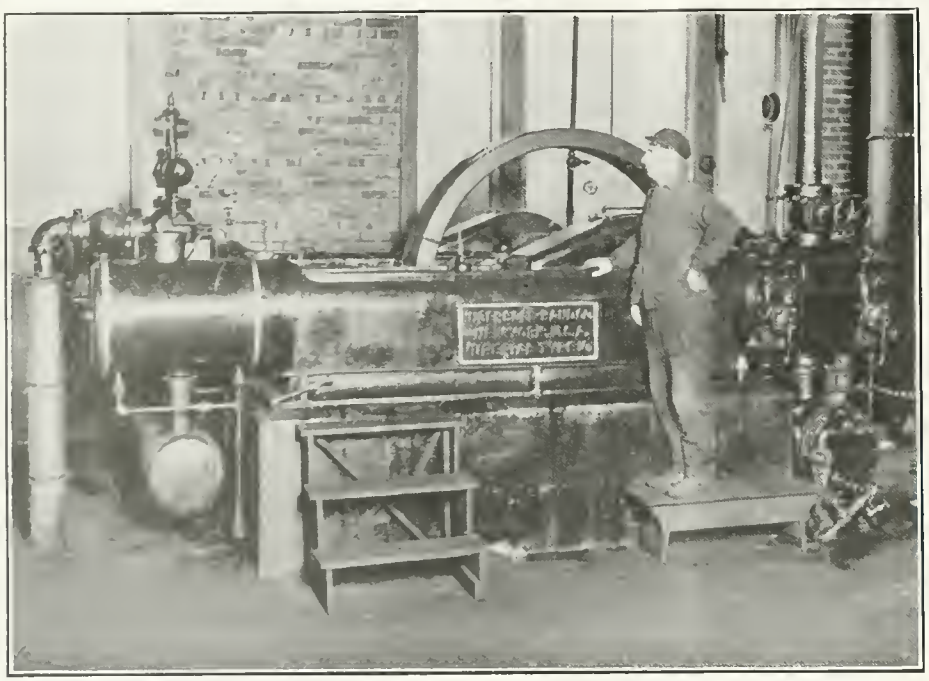
In the earlier days, lamp chimneys were blown "off-hand," and subsequently some of them were made in molds. Latterly, lamp chimneys have been largely fashioned by means of "paste-mold" machines. The evolution of bulbs for the incandescent lamp has been a gradual one; and while apparatus have been devised for fabricating them mechanically, it seems that the majority of them are even now produced by the hand worker. The first glass bulbs were formed from tubing, which was manipulated over a flame and distended by the breath of an expert operative. The initial efforts to make bulbs direct from molten glass, by means of the glassworker's blowpipe, originated in the late "seventies" at Corning, New York. After much experimenting with glass of different compositions and with various ways of manipulating the material, a process was hit upon for manufacturing so-called off-hand bulbs which enabled the glassman to turn out a better product, inasmuch as the bulbs so blown were more uniform in shape, size, and thickness. Not only that, these bulbs were distinguished by certain desirable physical properties, such as correct coefficient of expansion, fusibility, freedom from visual defects, etc. The bulbs could be put out fast

Nipping off a gob of plastic glass preparatory to forming the base of a vase. Nice judgment is required on the part of the worker to cut off just enough glass to meet his requirements.

Putting the finishing touches on bar glassware after the little tumblers have been modeled in a hand press. The furnace at the right is a "glory hole."



A close-up of a hand press in which tumblers are being formed. The pressman is throwing the lever to make a tumbler in one mold while his associate gatherer is getting glass from the furnace to fill a second mold.



Imperial Type X Compressor installed at Allegheny Plate Glass Co., Tarentum, Pa.

enough to meet the demand at that date, and were of a type that could be fashioned in prevailing glass plants and by craftsmen then available.

As might be expected, as the art of lamp making progressed and incandescent electric lighting was more and more widely adopted, it became obvious that machinery would have to be substituted wherever practicable. In order to appreciate the functions of the mechanical agencies it is needful that we sketch briefly the steps followed by the essentially hand method. In the off-hand process the blower gathered a small "gob" of glass on the end of his pipe by dipping the latter in the molten mass. Next, he rolled his "gather" on a polished iron plate, shaping it into an approximate cylinder as it cooled somewhat. Then, by a combination of blowing and swinging, he caused the glass to elongate and to distend into globular form. As no measuring tools could touch the plastic glass, the approximate uniformity of the product depended entirely upon the dexterity of the operative. As this procedure left much to be desired, the glass manufacturer, in order to secure a larger degree of similarity and accuracy, wisely adapted the familiar wooden-mold to his end. This method had long been used for the production of globes, chimneys, and kindred articles.

Up to a point, both the off-hand and the wooden-mold practice are alike, but when the gather or blank has been partly expanded in the latter case, by the blower's breath, it is placed within a water-soaked, hardwood mold. As soon as the mold is closed the worker blows into his pipe, rotating it the while between the palms of his hands. This motion revolves the blank and causes it to assume the form of the enveloping mold. When the glass has chilled sufficiently, but before it has entirely lost all of its plasticity, the mold is opened and the bulb, still attached to the blowpipe, is removed. The concluding act is to detach the bulb from the pipe by means of the cracking action of a wet or cold tool.

Before long, the glass manufacturer found that his wooden molds were not an unmixed blessing, for they were apt to warp quickly and to burn out of shape and thus correspondingly affect the product. There was need of a more durable material, and this was discovered to be cast iron, which, when coated with a paste composed of linseed oil and charcoal or hardwood sawdust, proved entirely satisfactory. The paste mold had its origin abroad; and was introduced in this country by itinerant French chimney or tumbler blowers who jealously guarded the secret of their paste. The action of this paste is to give the glass in contact with it a pronounced polish.

In time, to be exact in the late "eighties," American glassmakers learned how to properly coat the inner surface of their molds, and from then on substantially all incandescent lamp bulbs in this country have been blown in cast-iron molds coated with a carbonaceous paste. The pasting is done by first covering the inner surface of the mold with a thin layer of boiled linseed oil, and next the mold is dipped in powdered charcoal, fine sawdust, or perhaps cork flour. After that it is jarred to remove the surplus powder before placing the mold in a baking oven, where the heat serves to partway carbonize the oil and the adhering powder.

At the proper moment the mold is taken from the oven and allowed to cool. To complete the carbonization of the paste, a particularly heavy gather of glass is picked up on a blowpipe and put into the mold where, when the latter is closed, the glass is blown snugly against the coated surface of the iron. The great heat of the glass transforms the carbon into an extremely thin, smooth film, which is nearly graphic in character. Before the mold is ready for service, however, it must be dipped in water. Indeed, this procedure is an essential part of the process and has to be repeated each time before a bulb is blown.

If water were not used it would not be possible to rotate the blank or gather of glass in the mold, and the resultant article would

Making lamp shades in an unpasted mold. The final blowing is done by means of compressed air tapped from the overhead, high-pressure conduit. The "blocker" at the left is making ready a second gather for blowing.

Blowing a lamp bowl in a pasted mold. The operative is rotating his pipe the while. The woman attendant opens and closes the hinged mold at the right moment, and also swabs it with water after each blowing.

Drawing out a gather just before blowing the body of a vase in a mold. Note the pedal and the hinged platform which control the opening and the vertical movement of a paste mold which is submerged in a tank below the margin of the picture.

have a rough or pitted surface. As it is, the paste-coated interior of the mold, in combination with the rotary motion given the glass, imparts to the ware, be the latter a bulb or a lamp shade, a beautiful, shiny finish.

Of late, a variety of machines, both semi-automatic and automatic have been devised which promise to cheapen and to improve bulbs so manufactured for incandescent lamps. Apparatus of this sort have been employed since 1898 in several plants; and besides making electric light bulbs they are used to good effect in forming lamp chimneys, tumblers, and other seamless glassware. For this service compressed air again evidences its admirable qualities.

The paste-mold blowing machine is arranged to carry a series of revolving molds which are successively brought into action. With the semi-automatic equipment the *modus operandi* is somewhat as follows: Glass is gathered by hand with a blowpipe; the gob is shaped on an iron plate and slightly blown; and then the pipe is gripped perpendicularly in a socket directly above the open mold. The machine next lowers the glowing mass, and the mold closes about it. At the same instant, compressed air enters the pipe through a mechanically-controlled valve situated at the upper end of the iron tube. While the air is distending the glass, so that it will conform to the contours of the mold cavity, means are provided by which the blowpipe is rotated, and this action serves to polish the outer surface of the ware and to prevent the formation of seams.

When the apparatus has made a half turn, during which time the globe, chimney, or other article has been blown, the mold opens; the pipe with its attached article rises; and the mold is automatically dipped into a batch of water for the purpose of keeping the paste lining wet. It is claimed that these machines can work much faster and fashion commodities superior to those manufactured by the older and more widely employed method.

It is reasonably certain that apparatus of this sort, using compressed air, will undoubtedly revolutionize this department of the art just as allied equipment have wrought wonders in the production of bottles, jars, demijohns, etc. From a small beginning, three decades back, the making of electric light bulbs has grown to a business of large proportions, and the output averages about 1,000,000 a day in this country. We have in service at the present time quite 200,000,000 of these lamps.

Attaching a punty to the base of the body of the pitcher before cracking off the blowpipe at the right.

In the manufacture of tableware, the pressing machines are either of a stationary or a rotary model. When the mold of a stationary machine is filled with plastic glass, a side lever is pulled, and a vertical plunger descends into the mold, thus squeezing the yielding substance into the desired shape. This type of apparatus may have one or two molds, which rest upon a stand and can be shifted by hand. The mechanically-revolved machine carries a larger number of molds, secured for the time being to the rotating table, and according to the design of the apparatus, the molds may be filled by hand or automatically charged by a flowing device which pours into each of them just the right quantity of fluid glass.

The kind of ware that can be made on a pressing machine is restricted primarily to commodities in which the openings taper downward so as to allow the plunger to be easily withdrawn after it has done its work. When a solid mold is employed, the outer surface of the articles, such as smooth tumblers, smooth nappies, etc., must also be of a downward tapering shape so as to facilitate removal after pressing.

In some pressing machines the molds are emptied by an air-operated piston which, rising through the bottom of the mold at the right moment, lifts the ware so that it can be gripped by automatic or hand tongs. When the goods are made by a hand press, compressed air is relied upon to cool the glassware and possibly the molds; and air at a lower pressure is blown

Here we see the pitcher, with the spout modeled, just about to have its handle fashioned from an attached "gob" of glowing glass.

The first stage in the making of a hand-blown pitcher. Forming the body in a pasted mold.

The air brush at work tinting electric-light globes. The hurtful fumes of the sprayed mixture are carried off by a suction exhaust system.

from convenient ducts for the purpose of lowering the temperature of the atmosphere about the workers. This is necessary, because the presses are located close to the melting furnaces.

And now, having covered broadly the general methods resorted to in the manufacture of blown and pressed tableware and lighting goods, let us follow more closely the practices in vogue in two typically up-to-date establishments devoted, respectively, to these two departments of the glass industry. To begin with, lighting glassware is divided into three groups: translucent, semitranslucent, and opaque; and these characteristics are determined by the composition of the batch or by the treatment to which the glass is subjected after it has been molded.

The glass is melted in a pot furnace, using oil fuel-combustion being stimulated and regulated by compressed air. The batches are charged into special fire-clay pots capable of holding 2,000 pounds apiece; and the time required to "bring in" a melt is about eighteen hours after the raw materials enter the furnace. The latter structure is large enough to accommodate a total of fourteen pots.

Encircling the furnace, and standing well away from it, is a large annular, overhead, low-pressure air duct, tapped every foot on the underside by outlets fitted with flap valves, so that the workers can get, as they wish it, cooling air for themselves and for the ware at certain stages of handling. Above this duct is mounted a small high-pressure pipe from which air can be drawn for various other purposes.

A gatherer takes from the melting furnace enough glass to fashion the desired commodity. He gives this a globular shape by slightly blowing it and revolving it in a wet recessed applewood block. With this done he passes the pipe to the blower who swings and slightly distends the glowing charge before lowering it into an open, hinged, hand-operated, cast-iron mold. If this mold be a pasted one the blower simultaneously blows into his pipe and revolves it to and fro while between his hands. In this manner may be formed large bowls for indirect lighting or lamp shades or globes of diverse sorts. Where the shape or design of the ware does not allow rotating during blowing, the blower, after an initial puff, shoves the mouthpiece of his pipe into a hose fitted with a flap valve, and compressed air fed through this does the rest of the work. It is sometimes claimed by the conservative handworker that better results are obtained by lung action when making bowls for indirect lighting, for he says that a more uniform distribution of the glass is thus secured. However, in the case of lamp shades, where the bottom is open, he admits that compressed air produces a satisfactory article—the sides being so nearly of equal thickness as to answer requirements. As a matter of fact, there is no reason why compressed air, controlled by an expert operative, should not do quite as well as the breath of the lungs, and relieve the artisan of much physical stress. Lamp shades are commonly blown double—i. e. end to end, and subsequently cut apart.

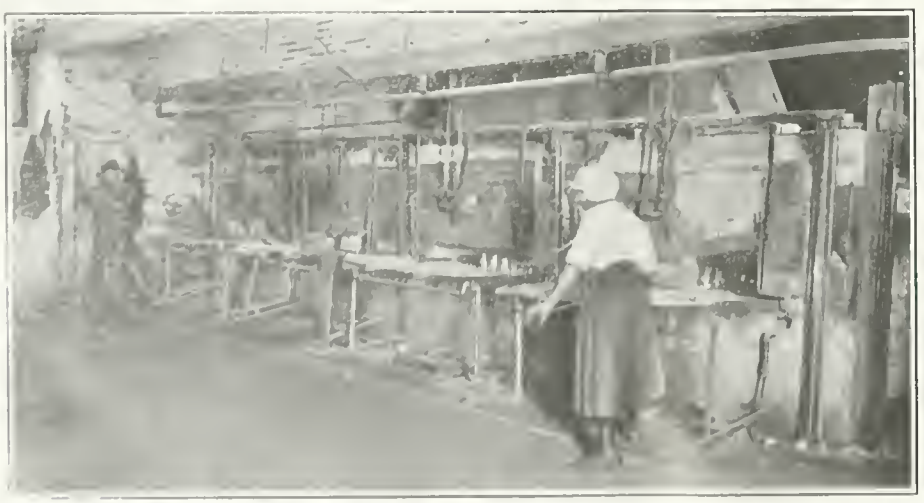
A view of the pot furnace in a tableware plant. Note the encircling air ducts and the various connections by which air is tapped from them for divers services.

After blowing, the ware is carried to annealing furnaces, and the interval between entering and leaving any of these ovens averages about three hours. The purpose of this treatment is to remove internal stresses set up during the blowing of the glass and its chilling upon issuing from the molds. Following annealing, the lighting goods have their rough edges trimmed off before undergoing grinding, which imparts a smooth finish. The concluding processes are broadly decorative, and range from subjecting the ware to sand blasting or an acid bath, to give the surface a frosted appearance, through the much finer work of ornamental cutting, tinting, or embellishing with colored designs. For tinting, the air brush is used to spray on the pigment; and when various colors are employed the pattern may be put on by hand or otherwise. The pigment is burned in by passing the ware through a leer in the opposite order to that practiced in annealing. That is to say, the heat gradually increases during the stay of the articles in the oven. In the cutting shop, where decorating is done, the commodity is progressively subjected to the action of a steel wheel, a carborundum stone, and a rapidly revolving cork disc. These successively serve to engrave and to polish the glass. Where the pattern is comparatively simple, one man may do all of the cutting; but if the design is at all elaborate, different parts of the ornamentation are handled separately by a number of artisans.

The blowing and the pressing of tableware, vases, etc., are especially interesting because of the variety of goods produced; and particularly in the after branch of the art much manipulative skill is required in fashioning and finishing the work begun in the mold.

In the manufacture of wine glasses by the hand press a "cup-foot" mold is used, and the first operation turns out what looks like a double-ended glass, one bowl being considerably larger than the other. When the ware is removed from the press it is carried to a small furnace, known to the trade as the "glory hole," where it is reheated to a plastic state. With this done, the evolving glass is passed to a worker who, with a wooden tool, called a buffer, finishes off the top. Next, the article is returned to the glory hole; reheated to the proper degree; and then withdrawn and delivered to another operative who completes the modeling of the stem and flattens out the smaller cup into the familiar base.

On the cheaper ware, it is customary to form the handles, etc., of pitchers, bowls, punch glasses, and the like during the pressing operation, but for the more expensive products the practice is to attach the handles after the ware



Carrying glass tableware through the lear or annealing furnace. The conveyors are made up of a series of heat-iron trays which are moved along by endless metal belts.

has been initially shaped in a mold. In the production of the better grades of pitchers considerable dexterity is required, and the procedure from start to finish is as follows: First, the gather is slightly blown and rolled by hand in a hemispherical recess cut in a block of cherry or applewood; then the shining globe is elongated on a metal slab or "marver," after which it is passed to the blower who places the incandescent mass in his pasted mold and blows it—rotating his pipe the while. With this done, the pitcher in embryo is put in the glory hole, and when properly plastic it is given to another operative who squares up and smooths the base, and, by means of a wet swab, induces a fracture at the top, by which the body of the pitcher-to-be is detached from the blow-pipe by a light tap.

Prior to this a heated "punty" or iron rod is cemented to the base by a bit of glass, so as to facilitate handling. Back to the glory hole the ware goes to soften the top to enable the glassworker to shear off excess material and to fashion the spout by the forming pressure of a suitable tool. But before this is undertaken the artisan skilfully smooths up the body, using for this purpose small tongs equipped with cherry legs. The concluding creative act consists in transforming a gob of plastic glass into a handle. Thereafter, the punty is detached, and subsequently the base is trued up by grinding.

The blowing of vases begins with the gatherer forming a truncated cone of incandescent glass, and the blower elongates this by drawing out the lower end with metal pincers, after which the stem and the body of the vase are blown in a mold. The foot or base is put on later by another man who deftly models a bit of attached plastic glass by a rolling movement—using the while a carbon buffer and then a wooden one. The wooden buffer is of cherry; and that tool, as well as the carbon one, is frequently dipped in a near-by bucket of water. In fashioning the base of a blown goblet or a vase the trick lies in cutting off from a gather of glass just enough material to work up into the desired shape.

The exit end of a leer in a glass plant engaged in the manufacture of tableware. The stacked articles are ready to be sent to the finishing department.

When the blower has received a glass-laden pipe from the gatherer, and has blown into the charge and manipulated it, he steps forward onto the trap or hinged section of the platform and depresses it, and this causes an open mold to rise out of a tank of water beneath the platform. After he has placed the gather in the mold, he presses upon the pedal with his foot, and this closes the mold.

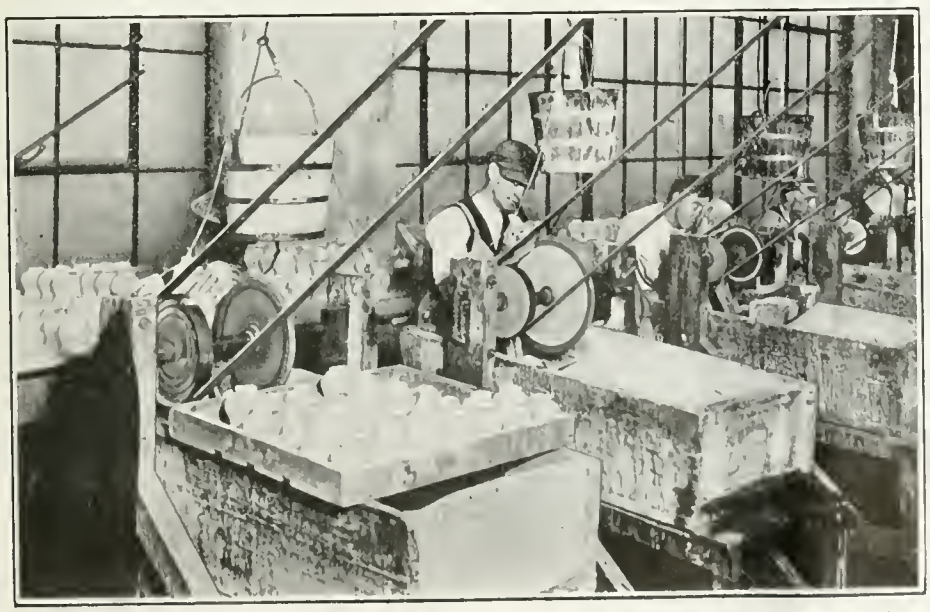
When he has finished his blowing, he releases the pedal, the mold opens, and the formed ware is removed. On stepping back to his original position, the trap rises, and the mold descends into the tank. An outfit of this sort is used with pasted molds or "pots," as they are sometimes termed; and a skilful blower can get good results from such a mold for three working days, each of eight and a half hours.

Depending upon the nature of the commodity and the finish required, the raw edges are smoothed off either by grinding or by a fusing process. For the latter, the articles are placed upon a "merry-go-round" or revolving table, where the edges to be treated are exposed to the action of a series of gas jets.

Various means are employed to trace patterns or to produce decorative designs on blown or pressed glassware, such as sand blasting, acid etching, cutting, painting, or a combination of some of these methods, all of which are more or less expensive according to the amount of handwork demanded. When the "decalcomania" process is resorted to, the design is first printed on paper, which is then pasted upon the glass. After that the paper is rubbed off, leaving on the glass only the ornamentation stenciled in acid-resisting ink. The next step is to cover with a coating of paraffin the rest of the glass which is to remain untouched. When the article in this condition is exposed to an acid bath, the corrosive fluid attacks only the areas not protected by ink or wax. In some establishments, the melted paraffin is applied to the glass by a sprayer with a compressed-air impulse. This brings us to still another use of compressed air in connection with a needle-etching machine.

This apparatus is equipped with from three to four arms which are so oscillated by pattern-forming cams that it is possible, with the needles inserted in these arms, to trace rather complex designs repeatedly upon tumblers coated with paraffin. A single machine will thus prepare for the acid bath anywhere from five to seven tumblers a minute. The acid acts upon the glass which is bared by the needles. The needles are actuated by compressed air, and the ware is held in position on a revolving platform by means of suction. This device not only simplifies and speeds up this preliminary work but it likewise reduces the cost of decorating.

It would not be fitting to end this article without briefly referring to cut tableware, etc. There are two kinds of cut glass: light or engraved, and heavy or deep cut. The cutting or engraving is done on blown or pressed blanks by holding these forms against revolving wheels. In the first process, called roughing, the cuts are made with a steel wheel on which sand and water are poured; in the second a stone wheel is used for smoothing the cut; and in the third a felt wheel is employed for polishing. The ornamental patterns for the better grades of this kind of glass are cut in their entirety, while in the cheaper products a good deal of the design, which imitates cutting, is actually pressed in the glass when the blank is molded.



In the grinding shop of a factory devoted to the manufacture of lighting goods. The men are cutting designs upon globes for electric lamps.

Fumigating Freight Cars at the Mexican Border

Parasitic Forms of Life Are Exterminated by Exposing Trains of Cars to Cyanide Fumes

By S. R. WINTERS

COUPLE 60,000 box-cars into a single railway train, purchase approximately $100,000 worth of chemicals, and expose the 508 miles of freight to a poisonous gas—then you may have a faint conception of the magnitude of equipment and operations of the Federal Horticultural Board in its fumigation activities on the Texas-Mexican border for a twelve-month period. The gas-administering houses, located at El Paso, Laredo, Eagle Pass, and Brownsville, represent the most pretentious fumigating facilities in the world, having a combined capacity of disinfecting 250 railway cars a day.

The pink boll worm, an unbidden guest from Mexico whose ravages have taken such a heavy toll of the republic's cotton crop, and other parasitic forms of life in their disguised journeys from the Republic to the South into the United States are arrested at these death-dealing detention houses. The fumigation facilities are reinforcements, a secondary line of defense, if you please, to the inspection service maintained by the Federal Government on Mexican soil. Rats, insects, mice, snakes, centipedes, and a multitude of objectionable creatures find a certain death in these well-appointed gas chambers.

Even human life, concealed in box cars, is not immune from the poisonous fumes. The Mexican, who was cloistered in a cargo of baskets in an attempt to smuggle himself into the United States, had to beat a hasty retreat from his secreted quarters when exposed to a dosage of sodium cyanide. His ill-fated experience should be a warning to train-beaters that to ride in the absence of tickets on Mexican railway lines may impose other and more exacting penalties than those commonly prescribed by transportation authorities.

The pink boll worm infestation in the Laguna district of Mexico and the exportation of seed from that locality to the United States rendered imperative the establishment of an inspection force, composed of trained individuals recruited from the Federal Horticultural Board. This decision became effective in the spring of 1917. Cotton seed was banned, crevices of railway cars being searched for straggling lots of seed that might contaminate cotton culture. Mexicans were at first suspicious and even antagonistic to the enforcement of these regulations. The plant quarantine inspectors were endowed with the sobriquet, *Prado*, a Spanish term when translated into the Mexican application signifies, "Long nosed nosey individual." The parlance of the street, in American cities, would phrase it in the form of an injunction, "Quit putting your nose in our business." Prejudice against the service, however, was gradually overcome and the merits of the system have been revealed. Nagging objections have subsided, or to quote a happy expression of O. D. Deputy, chief inspector of the Texas-Mexican border inspection service of the United States Department of Agriculture, "Like the various other branches of the government on the border, it is indulgently tolerated if not particularly sought after."

The method of inspecting a railway car involves the ransacking of all portions of a cargo of freight, exploring cracks and crevices, for stray cotton seed. One inspector may examine 90 cars a day. Empty freight containers are quickly disposed of—they are either free from contamination and are thereby licensed for passage or fouled with seed and prohibited entry into the States until the shipper has instituted such renovation proceedings as to satisfy the inspector.

Cars containing cargoes of unassorted freight, however, entail difficulties incident to examination before they can be certified for passage. Suppose the consignment contains bulk lots of ore, bones, or guano, these being possible hiding sources for cotton seed. The ore, when sparingly distributed, is saturated with oil, and a fire envelopes the metal; bones are sprayed with oil, while guano, if fine enough, may be screened. One-third of the cars examined contain cotton seed, and the latter in many instances prove to be nurseries of pink boll worms. Such, in brief, is the inspection service on Mexican soil.

Taking up the main thread of this story, namely, the facilities and methods of fumigating car-loads of products consigned from Mexico to the States, the Federal Horticultural Board early realized the importance of a secondary line of defense for surmounting errors or taking cognizance of any omissions traceable to the inspection service, inherently susceptible to weaknesses. In the absence of gas chambers, for two years each car constituted its own fumigation house. Cracks were sealed and other methods adopted for making the freight container air tight, when poisonous chemicals were introduced. Flat, coal, and cattle cars, not lending themselves to snugness as is true with the box-car, were sprayed with kerosene. The crudeness, and even danger, of this makeshift arrangement was apparent, and, the efficacy of the procedure was restricted to the interior of the cargo-carrying container. The outside of the car was denied a dose of gas in a searching application for crop-destroying pests. The temporary arrangement was in effect until the fall of 1919 when well defined fumigation houses displaced makeshift quarters. Of these, the burden of this article, or, the unfolded portion of the story, is primarily concerned.

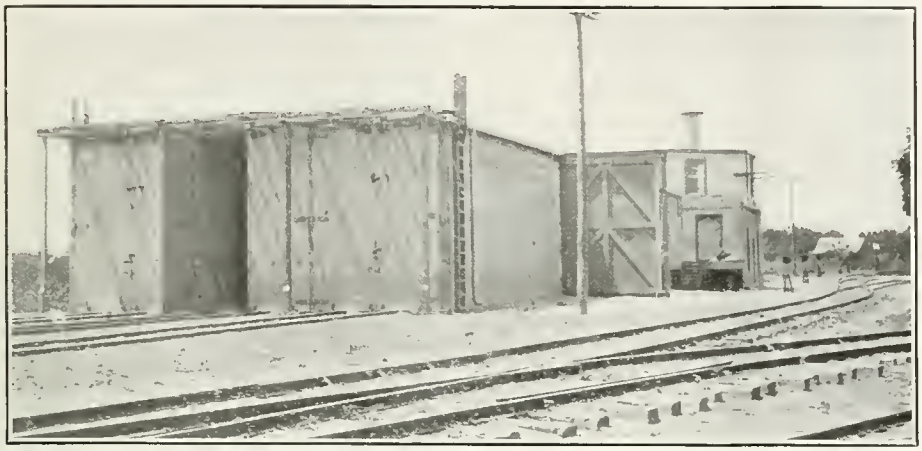
Fumigation house at Laredo, Texas. Five cars have already been placed and the train is carring in five others. The house has a capacity of giving gas to fifteen cars at a time.

Five fumigation houses located at Brownsville, Laredo, Eagle Pass, El Paso, and Del Rio, were erected at a total cost of $85,498. The expenditures include $1,975 invested in equipment for applying gas to automobiles, wagons, buggies, ox-carts, or other vehicles propelled by gasoline, horse, donkey, or steer. The chambers for applying sodium cyanide at El Paso and Laredo represent an expenditure of $28,330 and $23,814, respectively. The house at Eagle Pass cost $17,252, while the one located at Brownsville was constructed at an expense of $14,124. Commendatory of the partially self-supporting feature of the system is the fact that during the operation of these fumigation houses from October 1, 1919, to April 30, 1921, $77,612 reverted to the Treasury Department. The fund, approaching the investment required in building the world's biggest gas chambers, represented the cumulative fees levied for each railway car given gas, which is $4.

The fee is assessed to the transportation company bringing the carlot assignment from Mexico into the States, whether the products consist of guano or fruits. Congress justifies a continuation of the creditable system by having appropriated $139,840 for the present fiscal year. Another fumigation plant is being erected at Nogales, Arizona, this unit having a capacity for fourteen railway cars at a time.

The buildings are so arranged that a locomotive may convey its train of cars directly into the gas chambers, the doors swinging closed with such snugness as to liken them to the gates of a prison. The quarters are divided into compartments, where air cannot easily escape. For example, the El Paso building has three five-car compartments, each measuring 225 feet in length, twelve feet in width and sixteen and one-half feet in height. These divisional units are independent of each other, longitudinal walls making the divorce decree positive. The dimensions of the room, when measured as a single unit, are 225 by 40 feet, the largest gas chamber of the sort in the world. One of the compartments just referred to is further divided into two two-car rooms and one one-car room by means of latitudinal sliding doors, operating in grooves on all four sides.

This arrangement facilitates the fumigation of one, two, three, four, and five cars in the sectional compartment. In a word, this vast



Close-up view of fifteen-car capacity fumigation house on Texas-Mexican border where all the trains entering the United States are given a dosage of cyanide gas.

cemetery for crop-destroying insects lends itself to the fumigating ceremonies of a train of fifteen cars or any fractional part thereof. For the week ending July 20, 1921, at Laredo alone 603 cars were subjected to poisonous fumes. The buildings at Brownsville and Eagle Pass are not so pretentious, their capacities being, at a single operation, six and eight cars, respectively. The four houses on the Texas-Mexican border have a combined annual fumigating capacity of 60,000 cars, although only 25,000 apply for accommodations at present owing to the slackening of business.

The Federal Government manufactures its own gas, an auxiliary room being maintained in one corner of the fumigation house. The production machinery consists of tiers of tanks, one of which is composed of an acid drum and two bulky tanks for storing solutions of sodium cyanide; another layer of tanks is maintained as measuring containers for the cyanide solution, acid and water, to insure their introduction in correct proportions into generators; and a third tier is composed of the generators proper in which the death-dealing fumes are generated and from which they are distributed by pipes to the chambers of the plant.

The distribution of the gas is effected by a simple method. There are three generators, one for each large compartment. From two of these vessels are projected mains which lead to the undivided fumigation chambers where they each divide, conveying gas to the extreme ends of the roooms. The third generator has a lead that scatters in the proximity of i s source; a division in the interest of small fumigation assignments. The gas resolves itself into ratios of one-fifth, two-fifths, and two-fifths, these allotments going respectively to the one, two, and two-car compartments of the divisional room. Generator tanks, measuring units, and storage containers are interlocked by pipe manifolds so that, in the event that a piece of machinery becomes incapacitated, a substitute can be readily provided.

Obviously, the application of gas to 25,000 cars yearly involves the use of a large volume of chemicals. The records of the Washington office of the Federal Horticultural Board show that from October 1, 1919, to April 30, 1921, a period of one and one-half years, $49,450 were invested in chemicals. Differently expressed, approximately 80 or 90 tons of cyanide and ten or twelve cars of acid are consumed within twelve months for the specific purpose of making warfare on the parasitic immigrant from the troublous area bordering on the Lone Star State. Here, in the purchase of chemicals, and in sharing the burdens incident to the purchase of supplies and miscellaneous materials, the self-sustaining feature previously referred to asserts itself to advantage. Congress, in appropriating moneys for the Texas-Mexican border activities, specifies that the exact cost of fumigation must be assessed and collected. The original charge was five dollars for each car, but in the practice of economy the Federal Horticultural Board has reduced the fee to four dollars.

The shipment of corn, possibly contaminated by storage in cotton-seed bins, from Mexico into the United States introduced a fresh problem for Uncle Sam. The alternative suggested was to grind the corn into fine meal or sterilize the whole grain by heating it uniformly at a temperature of 200 degrees Fahrenheit for five minutes. The latter suggestion was adopted. Sterilizers were installed at El Paso, Eagle Pass, and Laredo. The machine operates on the theory of direct application of heat to the possible infested product. Fire from a furnace transmits heat immediately to the corn which is harnessed in a chute-like container. Gravity is a coöperating agent in exposing the grain to two hundred degrees of temperature. The machine at Eagle Pass harmonzes with this description.

The sterilizers at El Paso and Laredo function in accordance with the principle of exposing the corn to confined steam. The grain obtains admittance to a battery of revolving cylinders which, comparable to concrete mixers, have horizontal sides. The heating cylinders likewise contain a stationary core composed of a series of square pipes so situated as to present a sharp edge toward the side of the cylinder. Superheated steam is introduced in these pipes and over them the corn, supposedly contaminated with boll-worm-infested cotton seed, is permitted to trickle after having been elevated by flights. Passage of the corn through the machine in the specified time is guaranteed by slightly raising the feed end of the cylinder.

There is still another cylinder in which the heating core is absent. Here, in this container, the grain is likewise elevated by a flight of stairs and permitted to tumble; there being at one end of the cylinder a blower which at a single performance cleans and cools the corn—thus restoring it to marketable condition without jeopardizing cotton culture in the South.

So whether the occasion demands the laying bare of a subterfuge of Mexican women in attempting to convey fruit contained in a loaf of bread; the stuffing of pillows with boll-worm infested cotton seed; or the fumigation of an entire train of cars, the Federal Horticultural Board has revitalized the war-created phrase "they shall not pass" as applicable to parasitic forms of life from Mexico. From October 1, 1919, to April 30, 1921, 28,385 cars were inspected on Mexican soil and certified for entry into this country. Of this number, 18,070 cars were disinfected at fumigation houses. Only about 85 per cent of the carlot shipments entering at El Paso were subjected to a dosage of gas, a fact accounting for the discrepancy in the number of cars inspected and those fumigated. Six hundred and three cars at a single port of entry is the greatest number fumigated during any one week since the establishment of the Texas-Mexican inspection service.

Fumigation house at Del Rio, Texas, for exclusive purpose of administering poisonous gas to automobiles, buggies, wagons, ox-carts, etc., from Mexico.

RADIANT HEATING FOR COMFORT

A PAPER before the British Commercial Gas Association explained the difference between radiant heat and convected heat, and showed that the former, which was the sun's method, was the only natural and entirely satisfactory way of heating human bodies. The open coal fire gave out radiant heat, and so did the modern gas fire; but the modern gas fire had the advantage over the coal fire in having a much greater regularity of heating. In addition it provided a glowing fire almost immediately after lighting, whereas the coal fire took some time to "burn up" after being lit. A gas fire, too, could be easily regulated, and the heat of the room controlled in a way which was not possible with coal fires. The coal fire, moreover, was a smoke producer and a defiler of the atmosphere; while the gas fire was smokeless. Comparing the gas fire of today with that of fifteen or twenty years ago an enormous improvement in construction and design has taken place during that period. The gas fire of today is "hygienically perfect;" the increasing use made of it both by private practitioners and in large general hospitals proved that the medical profession was fully in agreement with that description.

PREPARATION AND STORAGE OF MINE TIMBERS

Perhaps no phase of mining is given less attention than preparation and storage of mine timbers, yet timber in many mines constitutes one of the principal items of cost, particularly in metal mines. Preparation may be considered under two heads—peeling and seasoning. The principal advantages from peeling timbers are: (1) lessens weight, (2) increases durability, (3) offers greater resistance to insect and fungus attack, and (4) promotes seasoning. Seasoning mine timber has the following advantages: (1) increases the strength and in some cases the durability, (2) decreases the weight and thereby reduces cost of freight and handling, (3) protects from insects and decay before the timber is placed in service, and (4) makes the timber more easily susceptible to preservative treatment. Usually timber storage does not receive the attention that it deserves. Proper storage is essential for proper seasoning, also for preventing checking and initial decay before placing the timbers in service. Timber yards should be well drained and free from vegetation and decaying wood. Timber should be placed on supports at least twelve inches from the ground, and should be so piled that air can circulate freely.

The American Locomotive Company announced recently the completion of an order by which the largest locomotives ever exported and the largest in use in any country outside the United States have been shipped to China. There were seven of the giant size, each with an overall length of 84 feet nine inches for locomotive and tender, weighing 320 tons when ready for operation, and with 3,000 maximum horse power. Forty were for passenger, light freight and miscellaneous use.

NEW TYPE OF BELT DRIVEN AIR COMPRESSORS

A NEW LINE of belt driven air compressors has been announced by the Ingersoll-Rand Company, 11 Broadway, New York. This type is known as the "Imperial" Type "XCB" and has incorporated in it several noteworthy features of construction, including plate valves, for both the air intake and discharge, and the five-step clearance control for regulating the compressor's output.

The plate valves used in this type of compressor have been perfected after a most complete analysis of the lightweight plate type of valve. They include the features which have been proved necessary to the successful functioning of this type of valve, the most important of these being, that the valve is supported throughout its entire operation in perfect alignment without any form of wearing guide—a very essential feature in the life of the valve.

The clearance control, it is stated, has been used with great success on the larger direct-connected electric motor driven compressors manufactured by the same company and has proved itself to be the most satisfactory and efficient form of compressor regulation. Thousands of these direct-connected air compressors are installed in all parts of the world and are well-known by those in charge of plants where conditions call for more than 600 cubic feet of free air per minute and where direct-connected electric motor drive is used.

The clearance control is a method of securing extremely efficient operation at partial loads. Under average working conditions it is well-known fact that the demand for air is seldom steady throughout the working day and for this reason the performance of the compressor at underload is of primary importance.

The entire control is automatic. If the compressor is operating at full load and the demand for air falls off this control automatically causes the compressor to operate at one of the underload points such as ¾, ½, ¼, or no load. When the demand for air is increased the compressor automatically assumes the load in successive steps.

An extremely valuable feature of the clearance control is the fact that the clearance pockets are made integral parts of the compressor cylinder and the entire regulation is obtained by the control of the volume of air taken in and compressed. With this method of control there is no loss of power due to wastage of air and leakage. The clearance pockets in the cylinder are automatically thrown into communication with the ends of each cylinder in proper succession, the process being controlled by a predetermined variation in receiver pressure. With the compressor operating at partial capacity a portion of the air is compressed into an added clearance space instead of passing through the discharge valves. On the return stroke this air expands giving up its stored energy to the pistons.

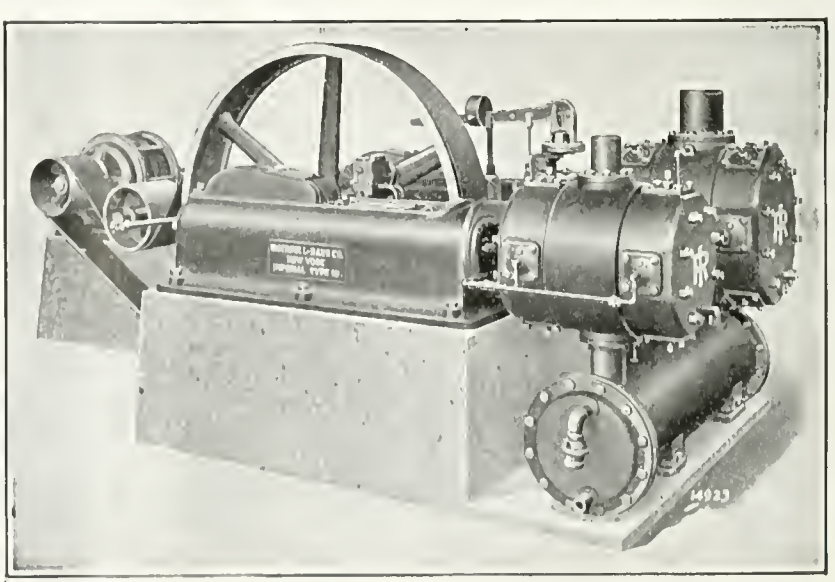
The inlet valves remain closed until the cylinder pressure equals the intake pressure. At this point the inlet valves are opened automatically and free air is taken into the cylinder for the remainder of the return stroke. Thus the inlet capacity is reduced without reducing the intake pressure. On a two-stage compressor, clearance space in proper proportion is added simultaneously for both high and low cylinders giving a constant ratio of compression and maintaining conditions necessary for the highest compression efficiency throughout the entire load range.

Another added feature of this control is the maximum demand stop which will prevent the compressor being operated at any higher maximum load than is desired.

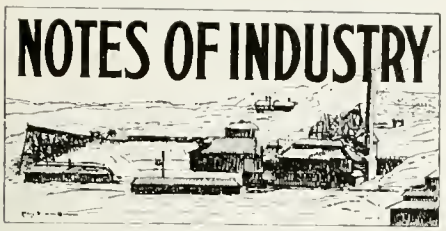
This new type of belt driven compressor equipped with clearance control can be furnished single-stage for low pressures and two-stage for higher discharge pressure. The piston displacement capacity for 100 pounds discharge pressure ranges from 610 to 1505 cubic feet of free air per minute.

This type of compressor can also be furnished with the short belt drive attachment with floating idler.

Bulletin No. 3042 describes this new type in detail.



New "Imperial" compressor which has just been announced.



The Pulverized Fuel Department of the Quigley Furnace Specialties Co., Inc., has been acquired by The Hardinge Company, 120 Broadway, New York, and the entire engineering department has been taken over practically intact. The Hardinge Company expects to further extend the system developed by the Quigley Company of handling coal supplies by pneumatic power.

A dry artesian well in Newark, N. J., has emitted a steady blast of cold dry air for 25 years, says the *Scientific American*. The owner, a woman, had this current piped into the house, where it keeps down the temperature in hot weather, dispels dampness, dries the family wash, and dispenses with ice in the refrigerator. The current is continuous and steady, and experts are at a loss to account for its source and action.

The army airship *Roma*, recently purchased from Italy, and afterwards assembled at Langley Field, Va., was expected to be ready for its series of American flights under direction of the Army Air Service.

Although less than half the volume of the late ZR-2, the *Roma* measures 410 feet from nose to stern, is 82 feet in width, and at present is the largest airship in this country.

Like the ZR-2, this is a hydrogen airship, but of the semi-rigid type, having a stiff keel. Driven by six 400-horse power Ansaldo engines, she is rated as having a good cruising speed for distances up to 8,000 miles with a load of about nineteen tons. Under favorable conditions the *Roma* is capable of making a non-stop flight across the continent, and soon after her preliminary tests are made the Army Air Service plans some long-distance reconnoissance flights over the country.

To establish a quick way of transportation for the diamonds mined in the Province of Kasai, in the Congo State, the company owning and operating these fields has acquired a number of airplanes, by means of which the stones are now being sent to their nearest destination, the town of Kinshassa.

"That Reminds Me, I've got an appointment with the dentist this afternoon."

The Monroe Calculating Machine Company, Woolworth Building, New York, has just brought out a new 20-Place, 16-Place and 12-Place Calculating Machine, shown for the first time at the recent New York Business Show. This wide range supplies a machine for every figuring need.

Calculation with speed and practically without effort is made possible by the easy, flexible, crank operation of the new machine. The operating crank also protects the work when interrupted. A quarter turn of the crank, a forward movement of the small lever just above the Non-Repeat Key and the crank can be removed. Then no one can use the machine or change a figure while the operator is absent.

Every feature of the Monroe is conducive to speed with accuracy. The key touch is light and the stroke short; the crank motion is fast and smooth.

The Imperial Corporation of London has purchased from the Czecho-Slovakia State mines, two grammes of radium to be rented to scientists and others who have special use for the radium. It is also hoped that a research laboratory may be established at Oxford University, but as yet plans for such a laboratory have not been made. The Imperial Corporation has also acquired the right of the entire output of the Czecho-Slovakian mine, amounting to four grammes per annum for fifteen years.

Mine operators will be interested in learning that the Treadwell Engineering Company, Easton, Pa., has placed a new line of hoists, both steam and electric driven, on the market. Among the features which distinguish these new hoists is a double-toggle clutch mechanism which is claimed to be a step forward in design. The clutch is usually mechanically operated by a double acting cylinder, although it can be arranged for hand operation if desired. A point is made of the fact that the clutch (of the hand type) drives directly from the rim of the main gear, which carries the driving portion of the clutch, to the friction flange of the drum. The design also includes tongue-and-grooved joints between all sections of the main frame to afford a rigid bolting together; motor and intermediate bearings are mounted on a one piece casting; provision for lubrication at all bearings, and the entire absence of cast iron in the mechanism of the differential brake, or brakes.

Several leaflets describing the new line of Branford Cleaning and Spraying Devices have recently been received. The many uses of these compressed air tools in the various industries are enumerated and the different types and sizes described in detail. An additional use brought forth for the sprayer is that of putting light coatings of neat cement on concrete that has been built up by the use of cement guns. The agitator type of sprayer enables this device to handle heavy liquids which can be located as far as fifteen to twenty feet away from the point of application.

Compressed Air Magazine

—Founded 1896—

Devoted to the mechanical arts in general, especially to all useful applications of compressed air and to everything pneumatic.

Business and Editorial Offices:
Bowling Green Building, No. 11, Broadway, New York City. Tel. Bowling Green, 8430

Publication Office: Somerville, New Jersey

Chicago Office: Sears & Irving, Representatives Peoples Gas Building

Business Office for the British Isles:
J. F. Atkinson, Representative
No. 31, Essex Street, Strand, London, W. C. 2

TERMS OF SUBSCRIPTION

$3 a year, U. S. A., American possessions and Mexico; all other countries, $3.50 a year, postage prepaid. Single copies, 35 cents. Back issues more than six months old, 75 cents each.

WILLIAM LAWRENCE SAUNDERS
President

G. W. MORRISON
Treasurer and General Manager

EUGENE P. McCRORKEN
Editor

ROBERT A. LUNDELL
Assistant Editor

FRANK RICHARDS
Associate Editor

ROBERT G. SKERRETT
Contributing Engineering Editor

MARY V. McGOWAN
Editorial Secretary

ARTHUR D. McAOHON
Secretary

FOREIGN CORRESPONDENTS

Paris
BEN K. RALEIGH
8, *Rue Saint-Florentin, Place de la Concorde*

London
ROLAND H. BRIGOS
No. 165, Queen Victoria St., E. C. 4

Berlin
CHARLES A. BRATTER
No. 23, Kochstr., SW., 68

Vienna
HERMANN BRINKMANN
No. 3, Tuchlauben, I

Madrid
LUIS BALDASANO Y LOPEZ
No. 7, Jorge Juan

EDITORIALS

TARIFF INCREASE ON DRILL STEEL A DETRIMENT

One of the important products involved in the proposed tariff measure to be enacted by the present congress will be the duty imposed on the importation of "fine steel" from Europe.

The tonnage of this material imported each year is not comparatively large nor is the revenue derived by the Government from this source of any great amount, but the use of this special steel of superior quality for certain specific and limited purposes is of the highest importance to the American industries that use it.

The quality of imported fine steel has for many years been the basis on which purchases in America have really been made. This is not a reflection on manufacturers of fine steel in the United States as will be shown in the following because for certain purposes America does not possess basic ores of the character of some of the ores which are mined abroad.

One instance of the harmful effects upon American industries by increasing the tariff on this kind of steel would be in the case of drill steel. Manufacturers of rock drills have found that superior advantages exist in the use of steel made from certain Swedish ores and also know that the foreign method of rolling hollow drill steel results in a uniform accurate product which permits tempering or hardening without the danger of producing flaws or cracks in the drill bar.

In testifying before the Finance Committee, Mr. C. F. SCHWEP, representing one of the large manufacturers of New York, requested that the present tariff rate of eight per cent. on hollow drill steel be allowed to remain in effect, instead of the higher rates prescribed by the Fordney bill. He pointed out to the committee that the old type of percussion drilling differs widely in principle from hammer drilling. The hammer drill, he said, uses hollow steel. With this type of drill the drill bar is tapped on the end. With the reciprocating drill the drill bar is clamped to the piston of the machine and therefore moves with the piston. This type strikes only about 500 blows per minute. Owing to the fact that the hammer type machine strikes about 2,000 blows per minute, the steel used in it must possess qualities which enable it to withstand this shock and vibration. Mr. SCHWEP declared that his company has found that there is something inherent in the Swedish steel, which is not revealed by analysis, which makes that steel much better adapted for the modern drill than is American steel.

An inferior quality of drill steel in general use will naturally react to the detriment of various American enterprises now under way or being contemplated such as mining, tunnel driving, road building, excavation for building foundations and in the numerous other directions wherever rock drilling must be done.

In a special brief on "The Metal Schedule" of the proposed FORDNEY Tariff Bill, submitted by a committee of "American Importers of Fine Steels," there is pointed out a few salient and significant facts. We quote the following from paragraph 304:

> Imported steels manufactured by the Open Hearth and Bessemer processes have been purchased in the United States for the past 50 years but have shown no recent increase in tonnage.
>
> The sale of such steels imported from Europe is extremely precarious because these metals cost much more than similarly made American metals and are sold only because of their superior adaptability for some process in American manufacture.
>
> It has always been proven that when the tonnage of any metal imported from Europe becomes of sufficient importance to cause the American metallurgists to develop a substitute, European steels as in the case of bicycle and other seamless tubing have been driven from this market.
>
> The margin of higher price which the European metals must secure over the prices asked for American metals made by similar processes is closely limited by how much the American manufacturer feels that he can increase the cost of his finished product. The closer the competition in the selling price of articles made by American manufacturers who have purchased European steels manufactured by Open Hearth and Bessemer processes, the smaller the volume of sales to this country because of the desire of these manufacturers to lower their production costs. This results in the constant development of new specialties by European metallurgists which, when recognized, are then adopted by American steel makers thereby excluding the European product.
>
> The Open Hearth and Bessemer Steel imported into this country never compete in price with domestic steels made by similar process, and are only sold in this country on account of high quality.
>
> The increase in the present proposed duty compared with the Underwood Tariff now prevailing is excessive and means prohibition of import of these steels, which in turn reflects less revenue and considerably increases costs to the American manufacturer, who may for quality sake still be required to use these imported steels, but this increase will be paid for by the American public.
>
> (Signed) MESSRS. HELMULTH, SANDELIN, SCHWEP, EK & SEWELL,
> (Committee on Preparation).

The proposed rate fixed by the FORDNEY tariff measure on this material is unnecessary for the protection of the steel industry of the United States. This prohibitory tariff will serve only to narrow and depress the market for imported "fine steel" which will prove both an injury to the American consumer and the Swedish and other European nations with which our commerce should be as little fettered as possible.

With the great preponderance of the world's wealth vested in America, the only way in which foreigners can purchase materials here is in products of their own. With over-production staring us in every direction, causing widespread unemployment, should we not seize an opportune outlet for this surplus by allowing some of the few things we can import with advantage go toward paying for our exports?

For, those who are scanning the business horizon for the rising sun of prosperity and good times know that a prime requisite is that America must have a market for the surplus of her crops and raw materials. We cannot export unless we import. Before the foreign exchange situation can again become normal there must be more evenly balanced buying and selling.

We believe that the attitude of the Senate is eminently fair and open-minded, the intention being to fix only a just tariff, and that the claims of importers of fine steels will be accorded a full measure of consideration.

THE HUMAN HANDICAP IN RECORD MAKING

THE MAKING of records of human achievements in the reaching out for the developing possibilities, and in the overcoming of our normal limitations, goes on almost without ceasing, the latest being continually superseded by a later, with no suggestion of any attainable finality. These records as they successively compel our attention are intensely interesting for the moment, and never more so than when they have to do with aviation, for nowhere else are our triumphs so accentuated. We far excel the speed and range of the animal world in traversing the surface of the earth, in skimming the face of the great deep and especially in shooting the reaches of the sky, outdistancing the birds both in speed of flight and in the heights attained, there being quite naturally more impulse to extravagant exultation over these latter achievements than over those of any other class that may have come before.

At the present writing the altitude

record in aviation is that made by Lieut. MacCready, when he and his machine rose to a height of 40,800 feet. Both the machine and the man seem to have very closely reached their respective limit, the one in the maintenance of sufficient power of propulsion and the continuance of its operation, the other in the retention of consciousness and the control of the normal bodily functions, so that it is not quite clear whether the achievement of the record is to be credited to the one or to the other.

When this situation is reached the matter does not generally stop there. Continued and unending improvements of the machine keep pushing it ahead, but beyond a certain limit the man can be pushed no farther, so that in practically every line the machine may be made capable of going or working where no man may accompany to operate or control it. The man in this aviation record case had his special supply of oxygen to sustain respiration, and his thick masses of clothing were electrically heated throughout, so what more could be done for him? That the engine went dead was only an incident that could be guarded against in the future, but if the man went dead that would be a different matter. There is of course a limit above which the flight of the airplane in our atmosphere must be forever impossible, and it may easily be believed that this limit of altitude flight will only be reached by a wirelessly directed machine and with no human being aboard.

But there are other records which the airplane is to make, and its initial handicaps will be inseparable from it all along the way. Our confidence is unbounded in its great future as a responsible factor in the practical and, as we might say, every day life of the world. It is to become established as our ready and ubiquitous messenger and common carrier of urgent mail and light valuables, and of many passengers later, but there are successive obstacles to be overcome in the process of its ultimate universal employment. The operators of the machines, the required professional fliers, physically and temperamentally fit, trained, equipped, experienced and sifted out to thorough reliability, do not exist and must be produced by processes more tedious than those of machine manufacture. Then the handicap of the possible passenger is vastly more prohibitive, or, rather, we would say, deterrent. Not one in four, perhaps not one in ten of average men can ever become, or be allowed to become, habitual passenger aviators, and then only after repeated trial flights. No one will ever be able to jump aboard for a trip of an hour or two or for an entire day as he would on a Pullman. Passengers will have to be recorded and certified, but even with these limitations we may be sure the number will continally grow and the service will extend into permanence and with extending reaches of flight. The developments in the line of established and regular aerial traffic in Europe, it is to be noted, are far in advance of those in the United States, and warrant us in optimistic views of the future.

When we start to penetrate beneath the surface of the earth or the water the handicaps or obstacles await and oppose us still more determinedly. The pneumatic caisson is very successful in opposing the pressure of the water so that men may work within it for building the foundations of various superstructures, but it does not go far down before the limit of human endurance is reached. For the bedding of the heavy towers which are to support the cables of the great Hudson River bridge at New York it will be necessary to go under water to a depth of from 140 to 160 feet, but men in the caissons cannot work below a depth of 100 feet, so that some other means for carrying the work to the required depth have had to be devised.

For penetrating deep down into the solid earth similar human handicaps are almost immediately encountered. It is imperative that we go to what we are accustomed to call considerable depths to obtain the coal and iron and various other materials to keep our industries going and make our lives worth living. Our utmost working depth up to the present may be said to be about one mile, with increasing difficulties all the way down. We have the power and all the mechanical appliances required to pierce to depths far greater than this, and many enticements urge us, but increasing temperatures and pressures soon become absolutely prohibitive. We dream of reaching a depth of twelve miles below sea level, but if we ever go as far down as we have gone up we will even then have much to boast of. R.

IMPROVED METHODS FOR OIL RECOVERY

MANY OF us can recall the Gallic imagery of "The Man With the Golden Brain," who gave heedlessly of his intellectual treasure until brought face to face with the logical consequence—poverty and the loss of the irrecoverable.

We, in America, are somewhat similarly circumstanced where it concerns our underground stores of petroleum. Time and again of late we have been warned that we are wasting these natural riches, and the technical men tell us that fully 40 per cent. of the subterranean oil has been drawn off since we began tapping our wells in the "sixties."

For a goodly while crude oil was nearly a drug on the market—those were the days when we used the material as a source of kerosene for our lamps and were gradually developing a demand for the lubricants which the petroleum yielded. Next, engineering skill devised ways to use crude oil for the generation of steam, and it was not long before liquid fuel had much to commend it in preference to the less effective, bulkier, ash-producing coal.

But these evolutions of service covered a considerable period, and we might still have far less cause for worriment but for the birth of the internal combustion engine and the subsequent conception of the Diesel motor. The gasoline engine made possible the automobile, the motor boat, the submarine, and the motor truck, successively; and then followed the airplane, the seaplane, the dirigible, the motorship, the farm tractor, and various types of self-propelled military machines. Liquid fuel has completely revolutionized the fighting fleets of the world, and oil-burning steamships of many sorts are transforming the merchant marine of the principal nations.

Looking about us ashore we see on every hand the rapid substitution of either the oil-fired boiler or the adoption of the internal combustion engine wherever circumstances warrant; and the result is a rapidly growing and insistent demand for larger and still larger quantities of crude oil and its manifold derivatives. There would be no reason for disquietude if our fuel wants were no more complex than a change from bituminous to anthracite coal or conversely. The substitution of either for the other might entail mechanical modifications to insure efficient service, but none of these would profoundly affect existing equipment or entail necessarily heavy outlays. But this cannot be said of the conditions brought about by our growing dependence upon oil as a source of motive energy.

As all of us know, each year that adds to our population, every decade that augments our industrial activities, make us rely that much more upon mechanical agencies in order that we may manufacture, produce, and move to and fro the tremendous tonnage of commodities essential to our commercial and our industrial life. Therefore, we must have fuel in plenty in the form of coal or oil and utilize in larger measure the impulsive force latent in our falling waters.

Dr. George Otis Smith, Director of the U. S. Geological Survey, put the situation fairly before us less than a year ago when he said:

"If we take 50,000,000 horse-power as an average figure for the potential water power of the United States, without storage, we find that if fully developed and if used at the average load factor of today, our rivers and streams would just about meet the country's present needs and would supply that amount of power for all time; moreover, with storage and improved load factor they could provide a considerably increased output of energy to meet the growing demand.

"If, however, we should put the whole burden on our coal mines, not using even the water power now used, we would find that by adopting the best steam practice of today the present power requirements of this country could be met with coal for 57,000 years, although we know that long before the end of that period the greater depth of the coal mines and their increased distance from market would alone create power demands for mining and transportation that would considerably cut down the amount of power available for other uses.

"The comparison becomes more striking and instructive when we consider the adequacy of the petroleum reserves of the United States to drive the prime movers of the country. Again adopting the best steam practice of today as known in the larger public utility stations, where fuel oil is used, and trying to carry the whole power load of the country with oil alone, we find that the oil reserves of the United States, although measured by billions of barrels, would last only nine years and three months."

The outstanding lesson of the situation confronting us is not that we have found oil a more effective fuel for steam raising, but that we are continually widening our dependence upon engines using either gasoline or heavy oil in their cylinders. In other words, we are

steadily increasing our reliance upon types of prime movers that would be of no avail without an unfailing supply of liquid fuel.

America cannot afford to shut her eyes to the writing on the wall. By every means possible we must conserve our remaining pools of petroleum and be heedful the while how we utilize this precious fluid. Finally, it is imperative that the expert resort to every expedient that will help him to recover the oil in the "pay sands;" and there are good reasons for believing that compressed air has a much larger and a more important part to play in this work than has been the case heretofore.

CHEMISTS PAY HONOR TO PRIESTLEY

THE MEMORY of Joseph Priestley, the pioneer of modern American chemistry, was honored recently by the presentation of his portrait, a copy of the original executed by Gilbert Stuart, to the National Museum in Washington. It was also largely in his honor that the American Chemical Society, which now has a membership of 15,000 was founded in 1876. He was the discoverer of oxygen, ammonia, sulphur dioxide, nitrous oxide and hydrogen chloride, which discoveries have proved to be of the utmost importance in the manufacture of fertilizers and explosives and the use of these gases for military purposes played a notable part in deciding the result of the recent war.

The discovery of the five rare elements of the atmosphere helium argon, krypton, neon and zenon within comparatively recent times was to a large extent the result of the original achievements of this illustrious investigator.

Priestley was a voluminous writer, his chief works being contributions to the chemistry of gases in six volumes among which are: *Experiments and Observations on Different Kinds of Air*, published between 1774 and 1786; *Experiments on the Generation of Air from Water* (1793); *Experiments and Observations Relating to the Analysis of Atmospheric Air* (1800).

Some of the views expressed in his writings regarding scientific research are interesting. In regard to the methods he pursued in conducting his researches according to modern standards, Priestley would not seem to have had an adequate conception of the meaning of ordered and deductive analysis. In reference to his preparation of oxygen, he says: "It provides a striking illustration of a remark I have more than once made in my philosophical writings and which can hardly be too often repeated, viz., that more is owing to what we call chance, that is, philosophically speaking to the observation of events arising from unknown causes, than to any proper design or preconceived theory in this business." While this is but a very modest estimate of his own accomplishment, it remains true that blind experiment—heating a substance, or treating it with some reagent—was his usual method.

Thus by heating spirits of salt he obtained what he called "marine acid air" (hydrochloric acid gas). Heating spirits of hartshorn he collected "alkaline air" (gaseous ammonia) because he was using mercury in his pneumatic trough.

Of the analogy between combustion and respiration Priestley had convinced himself, and in his paper on "Different Kinds of Air" he described experiments which showed that growing plants are able to "restore" air which has been vitiated, whether by breathing or burning a candle in it.

Thus it was that by such simple experiments were the fundamentals of our present modern chemistry of gases revealed.

It is remarkable that this eighteenth century chemist should be honored to-day for his discoveries, which nobody at that time could possibly realize were to exercise so vital and potent an influence upon human society in their economic aspects.

It is hardly possible to gage the future advances that will be made in this department of chemical science, but it is well within conservative bounds to say that the utilization of the various products of the air at the present, despite the many wonderful discoveries since Priestley's day, is still in its infant stage.

SONG OF THE REEF AT JOHANNESBURG

THE VISITOR to Johannesburg sooner or later becomes aware of a strange something in the air—a vibration rather than a sound—a remote, susurrant rumor, writes J. A. Nimmo in the *New York Evennig Post*. If of incurious habit he may pay no immediate heed, but everywhere he goes he is haunted by this soft, persistent note. As he approaches certain parts of the Golden City the sound increases in volume, dominating street noises, filling the atmosphere, until at last it breaks into a dull, grinding roar, like the thunder of heavy seas on a rocky coast. It is the roar of the stamp mills on the gold mines.

Night or day it never ceases. Travel along the fifty miles of Reef and you cannot escape from it. Sometimes faint, dreamy, like the sea murmur in a hollow shell; sometimes harsh, deafening, beating relentlessly on the tired brain; but never absent—the spirit of the Mines made vocal sings its tireless monody.

The Reef lies along the Witwatersrand like some gigantic petrified monster whose blood has crystallized to gold, and an army of human ants swarms in its vitals, tunneling and blasting, burrowing and tearing. Not willingly does nature surrender her rock-bound treasure and the Reef takes its yearly toll in human lives. But when did man in his strife with nature begrudge a blood tribute?

Into the cage go the toilers of the Reef Down, down, through abysmal gloom till the glare of the lamps and the rasping scream of the rock drills tell of the level reached! Lie in the narrow stopes, half-choked with dust, heedless of steel-numbed hands, of hammer-bruised fingers! Bore into the Reef, Men-moles! Drill! Drill! Let the dynamite strike deep, and the rocks be riven asunder!

So, toil the gnomes of this nether-world; sinking and driving, cutting and cross-cutting.

Above ground the trail of the Reef is plain. Towering headgears, mountainous cyanide heaps, forests of smokestacks—the long line of surface workings stretches from Randfontein to Springs. And up and down the Main Reef Road speed motor cars, bearing the minds that plan, the wills that direct. But ever above the voices of men, the hiss of steam, the workshops' din, is heard, the song of the stamps as they pound and crush the rock that yields the yellow gold.

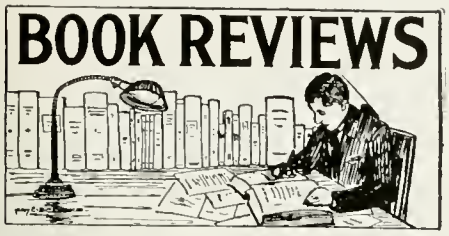
AIR TESTS IN VEHICULAR TUNNEL

TESTS MADE recently by the officials of the Bureau of Mines and others show that the vehicular tunnel can be successfully ventilated and made safe for all persons driving automobiles through the tunnel. Because of the highly poisonous gas, called carbon monoxide, which occurs in automobile exhausts, the New Jersey Commission, coöperating with the New York State Tunnel Commission, induced the Bureau of Mines to build a model tunnel in a mine in Bruceton, Pa., 130 feet below the ground.

For the past six months members of the Pittsburgh Experiment Station of the Bureau of Mines have been constructing and fitting up the model tunnel, which is eight feet wide and nine feet high and circular in shape. During this time ventilating engineers, chemists, physicians, and in fact representatives of all branches of science have been interested to determine the effects of motor exhaust gases, heat and smoke, etc.

After a thorough examination the officials of the Bureau of Mines, Mr. Holland, the chief engineer, and the commisioners, all went down in the mine together. The automobiles were spaced 50 feet apart, and 21,000 cubic feet of air per minute, or sufficient to maintain a concentration of not more than four parts carbon monoxide per 10,000 parts of air by volume were passed through the tunnel. The discharge of carbon monoxide from the automobiles was not noticed by the party, but on the other hand they said later that they could feel the fresh air passing through the tunnel. After an hour's ride the commissioners were again examined and after taking the temperatures and a few drops of blood from the finger of each commissioner to determine the amount of carbon monoxide absorbed in the blood, it was found that none of the commissioners suffered any from the effects of the carbon monoxide, but the results of the physical examinations cannot be definitely stated until the blood taken from the fingers can be analyzed.

The output of the coal mines of South Africa for 1920 amounted to 11,473,452 tons, valued at $21,932,133, as compared with 10,201,859 tons for 1919, valued at $16,603,852, according to Consul General A. A. Winslow, Cape Town. The larger portion of this coal was consumed in the Union, with exports amounting to about 2,000,000 tons. The balance was taken by steamships for fuel. It is estimated that South Africa could export 40,000,000 tons of coal annually if the industry was fully developed.



THE WORKING OF STEEL—Annealing, Heat Treating and Hardening of Carbon and Alloy Steel by Fred H. Colvin, Editor, American Machinist and K. A. Jutbe, Chief Engineer, American Metallurgical Corporation. Price, $3.00; 244 pages; New York: McGraw-Hill Book Company.

THE AUTHORS of this book for steel users have given the most approved methods of working the various kinds of steel now used commercially, including low carbon, high carbon and alloy steels of various kinds from a variety of industries. Since the automotive field has done so much to develop not only new alloys but efficient methods of working them, this field in particular has been drawn on liberally so as to show the best practise. The methods in government arsenals on steel used in fire arms are also given.

The book presents much valuable data of a very practical nature. It starts with the A B C of iron and steel, tells something of the making of steel and then shows how to make the best use of the steel in manufacturing. The subjects of forging, annealing, case-hardening, heat treatment are dealt with in considerable detail as are also the matters of furnaces, pyrometry and pyrometers. The tool maker is offered important information in the chapters on Hardening Carbon Steel for Tools and High Speed Steels. Some of the especially noteworthy features are the Practical Hints for Tool Steel Users, Instructions for Working High Speed Steel and Dont's in Handling High Speed Steels. Over a hundred illustrations are used throughout the book in explaining the various methods and practices.

THE ORGANIZATION OF MODERN BUSINESS, by William R. Basset, author of *When The Workman Helps You Manage; Accounting as an Aid to Business Profits, etc.* 271 pp. New York: Dodd, Mead and Company.

IN THESE days when business is becoming more and more a matter of scientific handling and the most successful business men are those who study and read most intelligently, this sane and practical book is of great importance.

The author who has had wide experience as an industrial engineer, and is the author of several books and many magazine articles on related subjects, deals in this volume with all phases of the management of business enterprises. However, the book does not describe the detailed methods of management, but confines itself to the policy side, dealing with the trend in business methods which have developed during the past few years. An enterprise, in order to succeed permanently, must move in harmony with this trend. The permanently successful business must first serve the customer, the workmen and the community and the profits which will surely follow such procedure will be a direct measure of the value of the service rendered. The author looks at business with the cold eye of the industrial engineer whose sole test is continuous profits.

Among other chapters there are the following: How Business Must Develop; Financing a Business from the Inside; Fallacies of Management; Getting Executive Leadership; The Use of Money in Business; etc. The writer does not favor any panacea, but he does lay down in detail eleven rules for managing a business which his experience has shown are essential to permanency and profit.

THE PORT OF NEW YORK. By THOMAS E. RUSH, Surveyor of the Port of New York. A complete treatise on the discovery, the early history and development, the consequent growth and trade of the port of New York, and finally the necessary improvements required to meet the demands of present day maritime traffic. Price, $3.50; 361 pp.; illustrated. New York: Doubleday, Page & Co.

THIS IS a book for the men who are directing the business of the United States, for the port of New York is the commercial keystone of the country. A book for students of commerce, of history, of manners—for all who are interested in our greatest port.

A romantic and diverting history told clearly and entertainingly. Pirate ships docked at its wharves, smugglers unloaded their secret cargoes. Gradually New York became the front door of the country.

In his discussion of the Free Port idea, his program for future development, his account of the American merchant marine, and his exposition of the importance of the port to the nation and to the world, the author presents vital and illuminating studies of the port problem.

The book will undoubtedly find an enthusiastic welcome among the general public inasmuch as the present agitation among political and commercial bodies for improved port facilities is commanding widespread attention. The author is well qualified to write on this subject, his official position affording him many excellent facilities to comprehend the whole situation.

This book will be found to contain much valuable information and will educate the reader to an appreciation of the part the port of New York is performing and will be called upon to perform in the future in aiding the commerce of the nation.

A "Selected Bibliography on Oil Shale," compiled by E. H. Burroughs, bibliographer, and M. J. Gavin, oil shale technologist, has just been issued by the United States Bureau of Mines. The bibliography, which is designated as Serial *2277*, refers to about 300 articles, papers, reports and treatises bearing on the technology of oil shale, and selected chiefly from the literature of the years 1915-1920. The references cited cover the oil shales of the entire world, and relate to the history of the industry; the geographic occurrence and geology of shale deposits; methods of mining, retorting, refining and utilization; the properties of shale and their determination; statistics of the industry; legislation and legal regulations; and economics. Copies of Serial *2277* may be obtained free by addressing the Director of the Bureau of Mines, Washington, D. C.

The Bulletin of the American Zinc Institute for September-October contains the Brief of the Institute, presenting the claims of the United States zinc industry for an adequate tariff, as submitted to the Senate Committee on Finance. It deals very comprehensively with the existing status of the industry. Another article in this issue has been widely reported in the metal markets, namely, a summation of world slab zinc conditions. It gives zinc market conditions in all the principal zinc producing countries. Interesting notes of the Zinc Institute are also included in this issue.

The "World on Wheels" is the title of a volume which is to cover the world's history of the cycle and automobile. It has been compiled and written by H. O. Duncan and will be sold on subscription through the author at 3 Rue Scribe, Paris, France.

This volume conveys much general information as to primitive ways and means, romance of the road, liquid fuel, and vehicles and automobiles of yesterday and to-day.

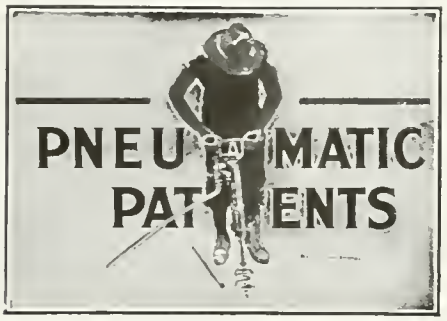
By the courtesy of the Swiss Government our Paris correspondent has received a copy of a beautifully printed and illustrated summary of the economic activities of Basle. Basle, which is spending great sums of money on a new inland harbor, is vitally interested in the navigation of the Rhine. The Rhine is now an international river and Switzerland's main outlet to the sea. Switzerland maintains that it should be used as such and not as a feeder for the canal which the French propose to build wholly in Alsatian territory. The water trade with Switzerland by way of the Rhine is growing swiftly. It has immense possibilities of further expansion. Engineering brains are even now at work on the problem of making water communication with Switzerland a simple, easy and inexpensive proceeding. This would envisage adoption of the latest compressed air practice.

PNEUMATIC DRILL OPERATES OIL PUMP

A CARLOAD of 5,000 gallons of fuel oil was received by the Canadian Brakeshoe Co. of Sherbrooke, which after unloading proved incorrect for their needs. The proposition that confronted them was the pumping of the oil from their tank up into the car, which meant a lift of from 22 to 25 feet and the only machine available was a No. 1 Goulds gear pump rated at ten gallons per minute.

Hand pumping meant the erection of a suitable platform on which to set the pump and the time of two men to operate it costing at least $20.00, not considering demurrage charges on the car. Their master mechanic while erecting the platform thought of using a No. 22 Little David pneumatic drill which they had and connected it by a set screw chuck to the spindle of the pump.

The pump and drill were connected up and started at 10.15 a. m. and the job was completed at 6 p. m., the drill running continuously without an attendant, thus saving some $15.00 in labor without considering the possible demurrage charges.



AUGUST 16

1,387,493. PERCUSSION-TOOL. William H. Keller and Albert Schinkez, Grand Haven, Mich.

1,387,510. MILKING APPARATUS. Edward J. O'Leary, Minneapolis, Minn.

1,387,515. ENGINE AIR-COMPRESSOR. Max Rotter, St. Louis, Mo.

1,387,591. BLOWPIPE-BURNER. William James Cooper, Smethwick, England.

1,387,713. MILKING-MACHINE. Palmer B. Hewlett, San Francisco, Calif.

1,387,942. MOLD-PRESSING MACHINE. Hugo Emil Pettersson, Stockholm, Sweden.

1,388,101. PNEUMATIC RAILWAY-GATE. Ross DeSimone, Hilton, N. Y.

AUGUST 23.

1,388,318. PNEUMATIC ACTION FOR PIPE-ORGANS. Willis E. Austin, Minneapolis, Minn.

1,388,326. TIRE-PUMP. Morris J. Chaikin, Detroit, Mich.

1,388,381. AIR-PREHEATING DEVICE. Leo. W. Schuessler, Chicago, Ill.

1,388,413. PNEUMATIC ACTION. Edgar Henry Dodds, Crouch Hill, London, England.

1,388,483. AIR-BRAKE CONTROL. Joseph S. Rasnick, St. Paul, Va., and Walker S. Blevins, Kingsport, Tenn.

1,388,526. HOT-AIR SYRINGE. Oscar H. Pieper and Alphonse F. Pieper, Rochester, N. Y.

1,388,565. VACUUM - DISCHARGE APPARATUS. Herman Heuser, Evanston, Ill.

1,388,670. FLUID - COMPRESSING APPARATUS. Robert Suczek, Philadelphia, Pa.

1,388,784. AIR-PUMP. Joseph C. Younghlood, Denver, Colo.

1,388,811. LOCOMOTIVE SANDER ATTACHMENT. Mack J. Fowler, Roanoke, Va.

AUGUST 30.

1,389,039. AIR-COMPRESSOR. Marshall A. Estes, Estes, Va.

1,389,070. AIR-BRAKE LOCK. Anton Wilhelm Paulson, Omaha, Nebr.

1,389,094. TRAIN - CONTROL APPARATUS. Andrew J. Brookins, Chicago, Ill.

1,389,165. ELECTRIC HOT-AIR HEATER. Oliver P. Scott, Tacoma, Wash.

1,389,360. AIR-PUMP. Walter M. Ingram, Baltimore, Md.

1,389,425. SUCTION FEED. Thomas A. Edison, Jr., Burlington, N. J.

1,389,445. OCEAN COMPRESSED-AIR POWER. Charles N. Hare, Lima, Ohio.

1,389,468. SAFETY PNEUMATIC WRENCH. William R. White, Bristol, Pa.

1,389,539. ROCK-DRILL. Thomas Turner, Ottumwa, Iowa.

SEPTEMBER 6

1,389,573. APPARATUS FOR COOLING MOLDS OF TYPE-METAL-SLUG-CASTING MACHINES. William E. Borst and Clarence C. Gilleo, Grand Rapids, Mich.

1,389,691. PNEUMATIC PIANO - PLAYER. Charles E. Peterson, Worcester, Mass.

1,389,789. APPARATUS FOR AIR-COOLING CYLINDERS. Frederick W. Peek, Royal Oak, Mich.

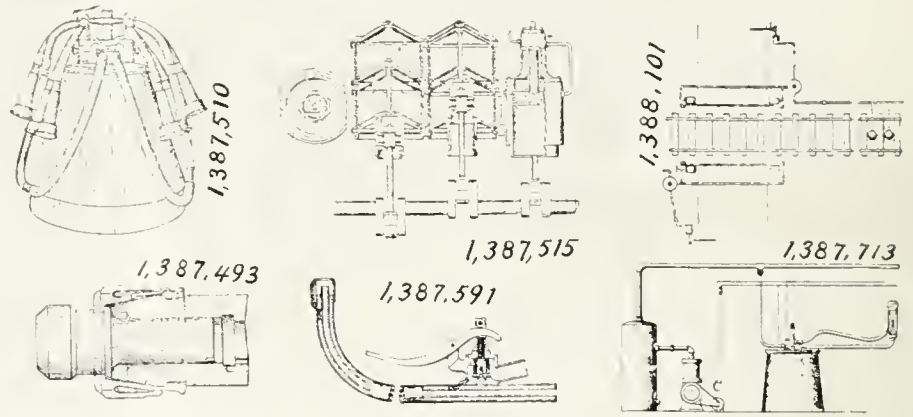
1,389,991. AIRSCREW HAVING ADJUSTABLE BLADES. William Colin Russell, East Sheen, England.

1,390,055. ELECTROPNEUMATIC BRAKE. George Mackenzie, Ltd., Pa.

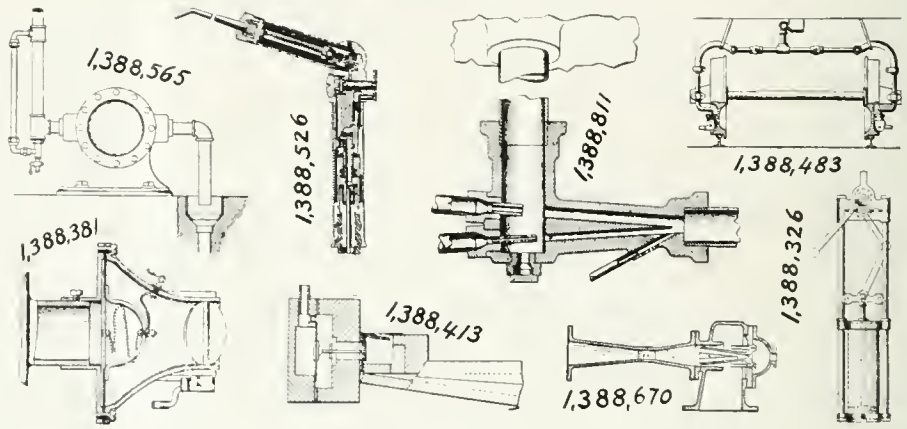
1,390,085. DELIVERY PUMP. Salvatore Cardinale, New York, N. Y.

1,390,096. AIR FILTER. Vito Di Sante, Wichita, Kans.

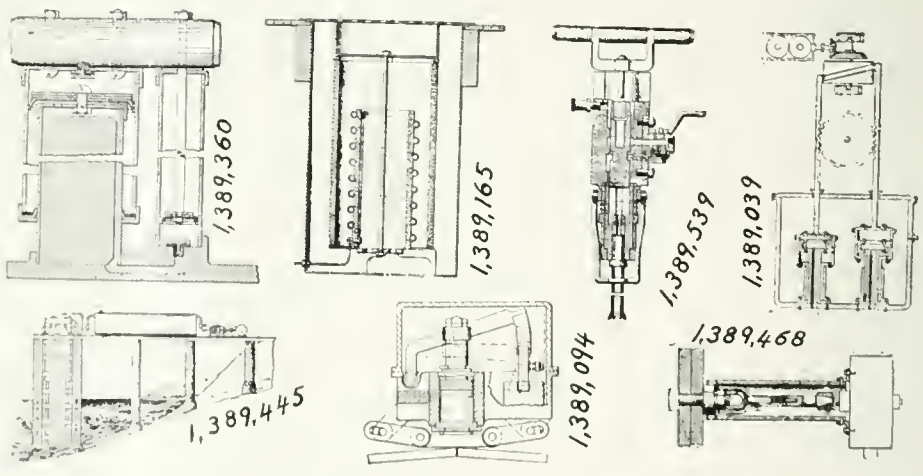
1,390,237. BLOWER AND EXHAUSTER FOR MOVING AIR AND GAS. Charles Markham Conder, Camborne, England.



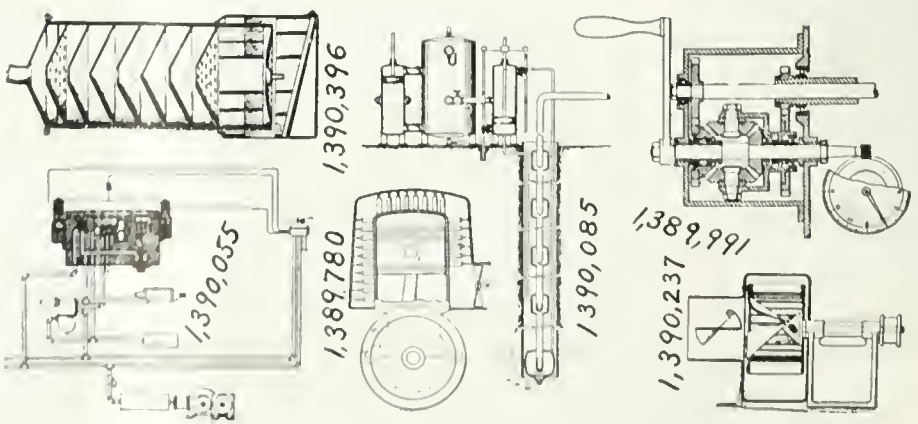
August 16



August 23



August 30



Sept. 6

International Trade Press, Inc.

The Big Road To Success

The man who rides the road to success is the man who has everything pertaining to his business at his finger tips. He's the man who follows and aids in the steps of advancement, watches the hatching of big ideas, the development of better methods, the forming of big plans and projects.

ENGINEERING WORLD brings the Engineering field to the desk of the executive, the contractor, the engineers, the builder, putting it at his finger tips aiding him to build a better business on a more efficient basis.

Because of its up to the minute editorial content, ENGINEERING WORLD is read by the leaders of the Engineering field, men who need your product and buy for the big jobs. Take your story to them through the advertising pages of ENGINEERING WORLD.

Let this highly influential paper come into your business. Let it aid you.

Subscription $2.00 A Year

ADVERTISE SUBSCRIBE

Get Results with the

ENGINEERING WORLD one of eleven publications is published by the International Trade Press, Inc.

Engineering World

A Journal of Engineering and Construction

542 MONADNOCK BLOCK CHICAGO

U. S. A.

IN YOUR PRODUCTION DO YOU USE
CASTINGS
FORGINGS
STAMPINGS
HEAT TREATED PARTS
SHEET
PLATE OR
STRUCTURAL
IN ANY SIZE, WEIGHT OR SHAPE?

PANGBORN SAND-BLASTS

HAVE PRODUCED IN OTHER PLANTS
BETTER QUICKER CHEAPER
CLEANING & BETTER FINISH
WITH INCREASED OUTPUT
AND LOWERED COST

AUTOMATIC · DUSTLESS · HYGIENIC
"A Type and Size for Every Requirement"

Competent Engineers To Aid In
Intelligent Selection & Application
Of Equipment Suited to Your Needs
Without Cost or Obligation

PANGBORN CORPORATION
HAGERSTOWN, MD.
SAND-BLAST SPECIALISTS
P. O. BOX 8504

SPECIAL OFFER

COMPRESSED AIR MAGAZINE for a year
One Copy "COMPRESSED AIR DATA"

$4.00

Compressed Air Magazine ($3 a year)

The only journal devoted to compressed air in all its uses and applications. Read it if you want to know all that is being accomplished with this great power.

Compressed Air Data ($3 a copy)

Latest handbook on "pneumatic engineering," contains all approved formulae, but is not written in too technical language. Every user of compressed air should have a copy.

Compressed Air Magazine,
No. 11, Broadway,
New York.

Send me Compressed Air Magazine for one year and mail at once postpaid one copy of "Compressed Air Data." Remittance of $4.00 enclosed.

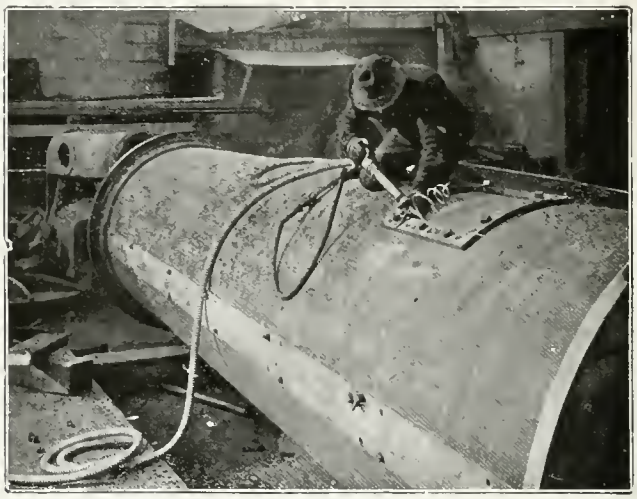
Name .....

Business or profession .....

Address .....

Sprague Steel Armored Air Hose

For high or low pressure service is most economical for use with all kinds of air tools and air drills. Also hose for Garage Service.

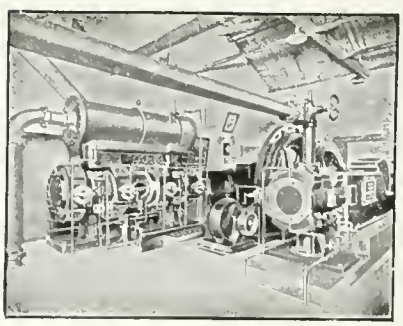


Sprague Steel Armored Hose is extremely flexible and so constructed that it cannot kink or burst and the fittings cannot blow out. It is recommended for use where hard service is required.

Write for Pamphlet No. B-3567

SPRAGUE ELECTRIC WORKS
Of General Electric Company
Main Offices 527 W. 34th St. New York
Branch Offices in Principal Cities

"Ultimately a Bury Universal 3-Cyl. 2 Stage Variable Volume Air Compressor; Why Not Install One Now?"



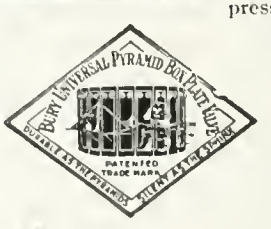
The largest American firms use the "BURY" air compressor — because of its **proven dependability.**

Back of the "BURY" lies 17 years of research, development and conscientious service to users.

If you are interested in the "last word" in air compressor improvements, send for the new "BURY" Compressor Booklet 407.

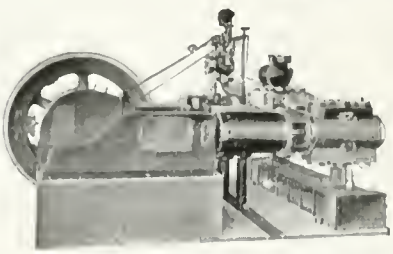
Do It Now!

The Patented Bury 'Universal' Pyramid Box Plate Valves are noiseless in operation and have 50% greater area than any other compressor valve.



Durable as the Pyramids

Silent as the Sphinx



Class "CCS"

Bury Universal type, Duplex, Compound, Steam driven. Built in capacities from 450 to 3000 cubic feet per minute.

All Sizes, All Types for All Pressures to Meet Any Engineering Requirements

Bury Compressor Co., 1101 West 17th St., Erie, Pa.

BAKER COOLER

(PATENTED)

The Standard Machine for Cooling Chemical and Metallurgical Calcines

"IT FLOATS"

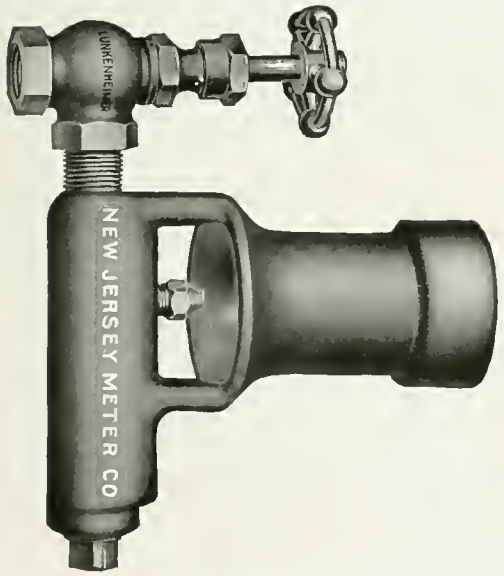
Derives its HIGH COOLING EFFICIENCY from Vaporization of water from the shell. Its small openings insure DUSTLESS OPERATION. Low speed and water borne weight cause LOW POWER AND UPKEEP COSTS. Cooling by Vaporization results in the MINIMUM WATER REQUIREMENT.

USED BY SUCH CONCERNS AS:

General Chemical Company
American Smelting & Refining Co.
Norton Company
Empire Zinc Company

THE STEARNS-ROGER MFG. CO.

Engineers, Manufacturers and Contractors DENVER, COLORADO



THE NEW JERSEY BLOWER

Turns a small volume of Compressed Air into a large volume of Low Pressure Air

Used for blowing forges and other purposes requiring large volumes at low pressures.

An ordinary riveting heating forge requires about 45 cubic feet of free air per minute. When taken from the Compressed Air line as is common practice, this consumes about 7.5 horse power. The Blower uses only two feet per minute (one-third of one H. P.) and draws in the other 43 feet from the open air. This is **"free air"** with a new and profitable meaning. Depending on your power cost, the saving will run from $10 to $25 per month per forge. Look over your processes and see what other applications you have for the "Air Transformer." Then send us an order for a few samples, $10 each, complete with needle valve and internal strainer, delivered anywhere in the U. S. A. Discount in quantities.

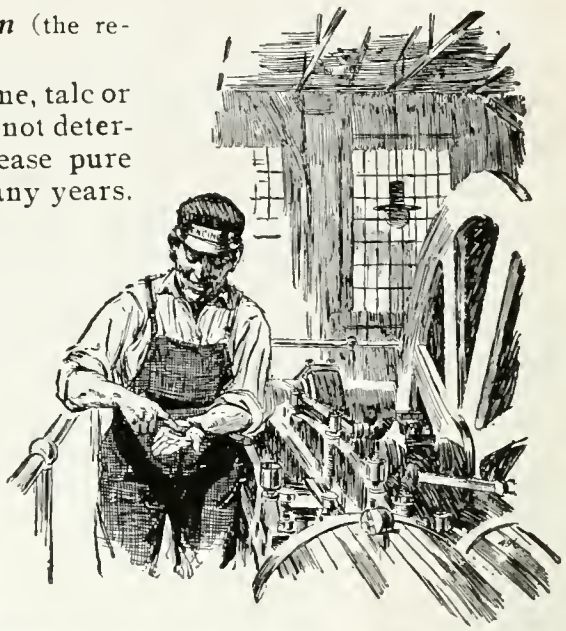
We specialize in devices for securing economy in Compressed Air Systems. Do you want our Bulletin 5-A on Air Meters or Bulletin B on the Blower shown above?

New Jersey Meter Company, Plainfield, N. J.

"Good as Ever"

—"*and we put that grease in there when we shut down* (the reserve machine) *months ago.*"

Albany Grease is a PURE tallow compound—no resin, lime, talc or other injurious ingredients—and because it is pure it does not deteriorate. We have records of engineers finding Albany Grease pure and sweet on engines and machines that had been idle many years.



Think what such purity means in protecting your bearings against corrosion. And there is no drip—no waste. You have better lubrication and save your time and money.

Ask your dealer—he stocks it because he knows it's good—or write us for a sample large enough to make a real test.

Ask for Bulletin CA-1.

REG. U. S. PAT. OFF.

A MARK

Known and respected around the world since 1868 for fair dealing, a quality product, and an unexcelled service.

ADAM COOK'S SONS
708-710 Washington Street
New York, N. Y.

C-74

Albany Grease

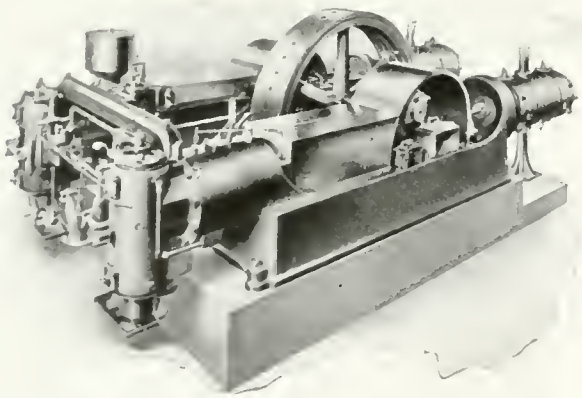


Illustration Shows 150 B. H. P. Twin-Type Single-Acting Four Cycle Gas Engine Compressor Unit.

Cheaper Air

Cooper Air Compressing Units are built for those who wish to reduce their cost of compressed air. These are two stage direct connected, 4 cycle Gas Engine driven machines built in standard sizes from 110 to 1300 B. H. P.

Cooper Gas Engine driven compressors are compact, require little floor space, and give uninterrupted service for years. Wherever gas is available no other source of power can compare with them in economy.

Write us for a complete record of their performance.

The C&G COOPER CO.

MT. VERNON, OHIO

50 Church St., NEW YORK Oliver Bldg., PITTSBURGH
Great Southern Life Bld'g., D[illegible]AS

Since 1833 Engineers and Builders

As a matter of reciprocal business courtesy help trace results

"The Operation of this Cameron Pump is entirely Satisfactory"

THESE are the words used by the officials of the Warm Springs Irrigation District, Vale, Oregon in speaking of the performance of their Cameron installation.

The pump is direct-connected to a water turbine. The inlet water supply to the pump is taken from the main line to the turbine, raised to the desired pressure in the pump and delivered to the fields for irrigation purposes.

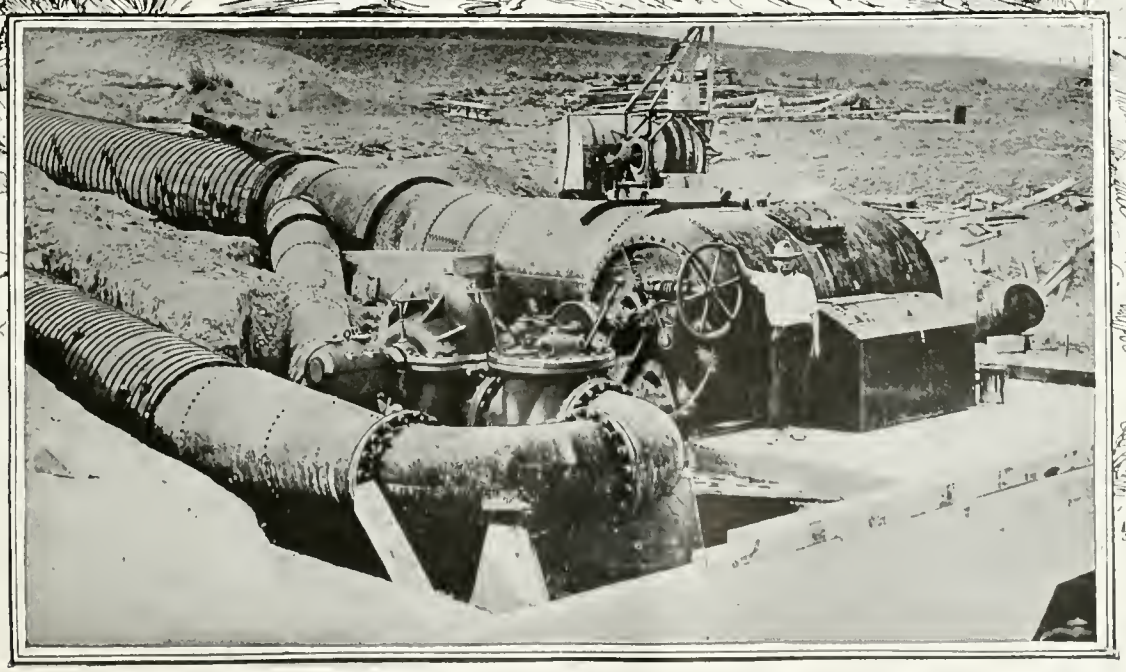
Recently a housing was built over the pump to protect it from severe weather conditions. This shelter was not built, however, until some time after the pump was on its foundation which proves again that Camerons do not need the surroundings of the modern power house to make them operate satisfactorily.

Write for Bulletin 7350

A. S. Cameron Steam Pump Works

11 Broadway New York City

Offices Everywhere



MACHINERY ILLUSTRATORS

Half Tones and Zinc Etchings

PHOTO RETOUCHING

Specialists in Wash and Line Drawings

JEWETT

24-26 Stone St. NEW YORK CITY

Correspondence Solicited

The Erie Unloader

New Style

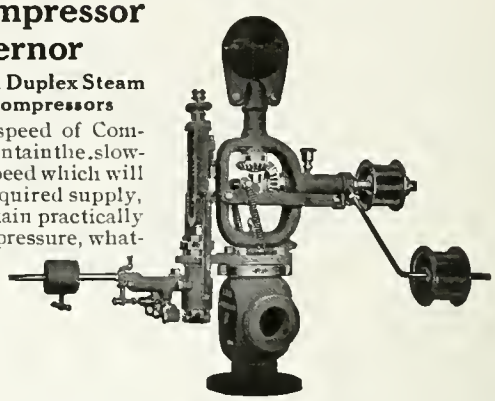
For Single, Duplex and Multiple Stage Steam, Belt or Electric Driven Air Compressors

Maintains practically a constant air pressure, whatever the requirement. Completely unloads and loads Compressor without shock or strain.

Erie Compressor Governor

For Single and Duplex Steam Actuated Compressors

Governs the speed of Compressors to maintain the slowest constant speed which will furnish any required supply, and will maintain practically a constant air pressure, whatever the requirement, if within the capacity of the Compressor.



Circulars on application to

JARECKI MFG. CO.

ERIE, PA.

The Perfection

Engine and Machine Washer

(PATENTED)

Used extensively in the mining industry for cleaning rock drills, parts and other mining equipment using compressed air in connection with kerosene, gasoline or other liquid solvent.

CLEANS AUTOMOBILES.

Also adapted for applying wood preservatives on mine timbers.

SAVES 90% IN TIME AND DOES A 100% JOB.

PRICE $8.00

M. W. BAILEY

30 Church Street, New York

Sole Manufacturer

Greater Lubricating Efficiency---Lower Lubricating Cost

follows the use of Keystone Grease No. 6. Won't exhaust with the air—even under the most difficult conditions Keystone Grease No. 6 keeps pressure uniform and eliminates shutdowns.

Let us give you the full facts.

No. KEYSTONE 6

TRADE MARK

Reg U.S. Pat. Off.

GREASE

The Master Lubricant

The Keystone Lubricating Co.

Executive Office and Works, Philadelphia

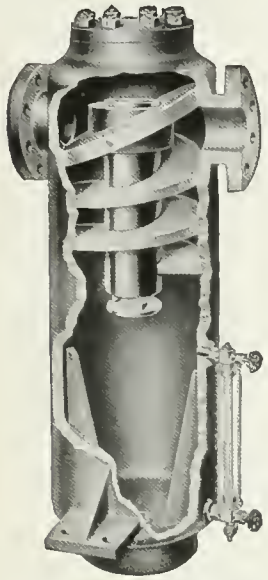
ESTABLISHED 1884

New York, Boston, Pittsburgh, Chicago, Detroit, St. Louis, Denver, San Francisco, Minneapolis, Montgomery, W.Va.

Agencies in Principal Countries Throughout the World

As a matter of reciprocal business courtesy help trace results

Are You Troubled With FREEZING AIR LINES?



COMPRESSED AIR always contains SOME MOISTURE, the quantity depending on the location of your plant. All water can be readily removed by installing a

Stratton Air Separator

The air will then go into the tools perfectly dry, eliminating any chance of freezing and in addition the efficiency of the tools will be increased; maintenance expense will decrease and the separator will pay for itself in a short time.

SEND FOR INFORMATION

The Griscom-Russell Co.

2117 West St. Building, New York

Philadelphia, Boston, Hartford, Springfield — Pittsburgh, Cleveland, Toledo, Detroit — Chicago, Minneapolis, Milwaukee, St. Louis, Denver — New Orleans, Houston, Fort Worth, Charlotte, Salt Lake City. — San Francisco, Seattle, Los Angeles, Kansas City

POWELL SPECIALTIES

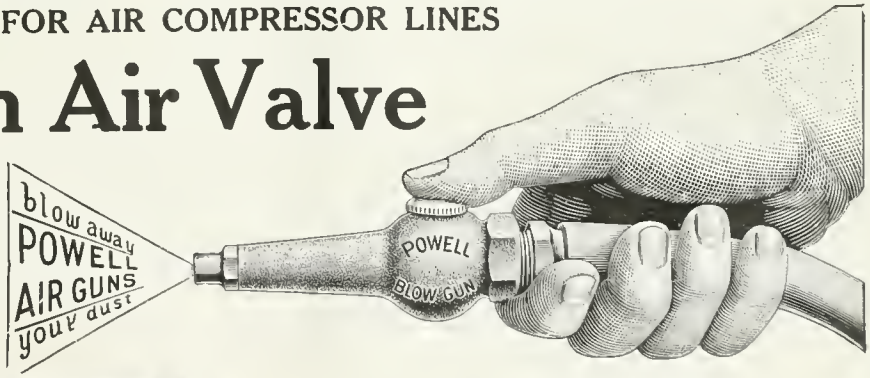
FOR AIR COMPRESSOR LINES

Blow Gun Air Valve

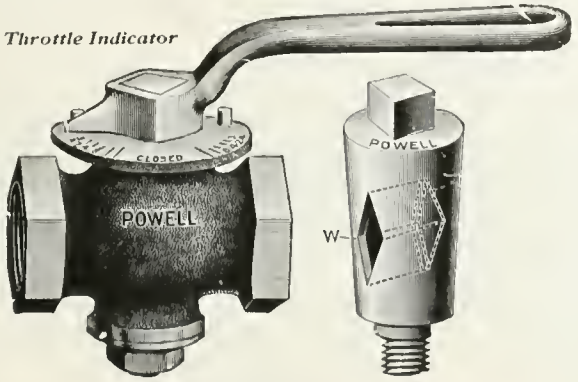
Cleans Work Benches and Machine Tools

SAVES AIR

Ask your dealer for "Powell Air Valves and Cocks" or write us.



Throttle Indicator



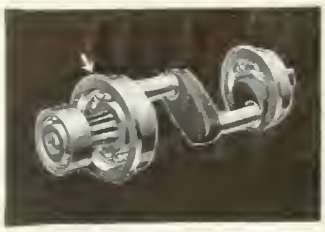
Brass Dialed Cocks

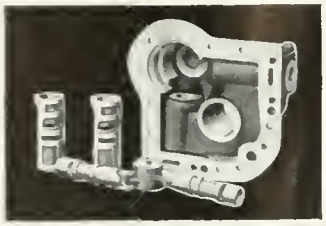
For throttling Air, Gas, Gasoline and Oil Engines. Diamond shaped opening through the key admits of very close regulation preventing all waste of air, gas, gasoline or oil.

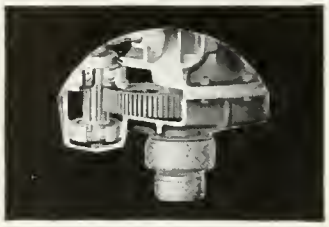
We manufacture a complete line of Brass and Iron Air Compressor fittings, Hose couplings, Hose Tails, Screw Nipples, Spuds and Straps.

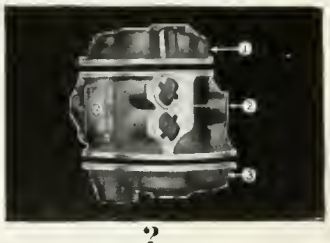
THE WM. POWELL CO.
CINCINNATI, OHIO

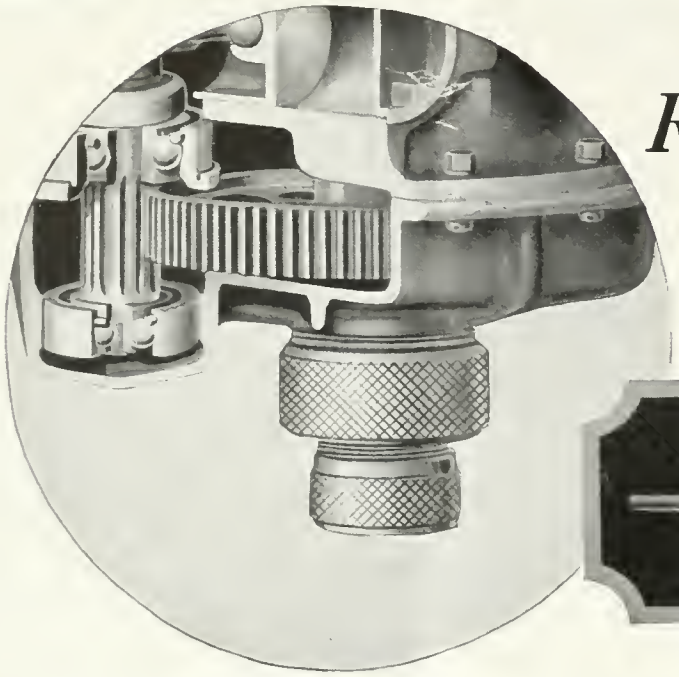
THE "BIG FOUR" REASONS WHY LITTLE GIANTS ARE THE WORLD'S STANDARD AIR DRILL


3-Point Crankshaft Suspension


Balanced Piston Valves

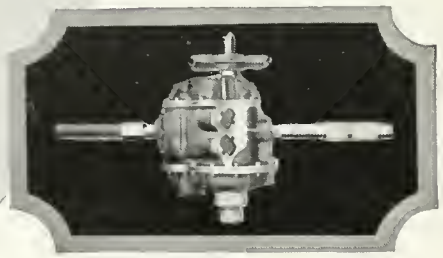

Sturdy Stub-Tooth Gears


?



Reason No. 3

Every need of drilling, wood-boring, reaming, tapping, and screw-setting operations is met by a wide variety of sizes and types of Little Giant Air Drills obtainable from Branch stocks. Address nearest Branch for Bulletin 598.


Little Giant No. 2 Air Drill
Non-Reversible Type

WHEN you think of the thousands of Little Giant Air Drills in year-in and year-out service, and their complete freedom from gear stripping and other driving gear difficulties, you're curious to know why.

The reason is—practically indestructible, sturdy *stub-tooth* gears, with teeth thicker at the roots and shorter in length, and thus stronger and more compact than the commonly used involute type. Result—no gear stripping; no crankshaft renewals; no unserviceable drills awaiting dismantling for crankshaft and gear replacements.

With the *users'* interests at heart, automotive engineers were quick to utilize the superior strength and dependability of stub-tooth gears. So were the engineers responsible for the World's Standard Air Drill.

Chicago Pneumatic Tool Company

Chicago Pneumatic Building · 6 East 44th Street · New York

*Sales and *Service Branches all over the World*

*Philadelphia *Boston *Buffalo *Chicago *Cincinnati *Cleveland *Detroit El Paso Erie Franklin Houston Joplin Los Angeles *Minneapolis *New Orleans *New York *Philadelphia *Pittsburgh Richmond Salt Lake City *San Francisco *Seattle *St. Louis Basle *Berlin Bombay Brussels Buenos Aires Christiania Copenhagen *Brandenburg Havana Hellingtors Honolulu Johannesburg *London Manila Milan Montevideo *Montreal Osaka Paris Rio de Janeiro *Rotterdam Santiago Sao Paulo Seoul Shanghai Tientsin Tokyo Toronto Vancouver Winnipeg

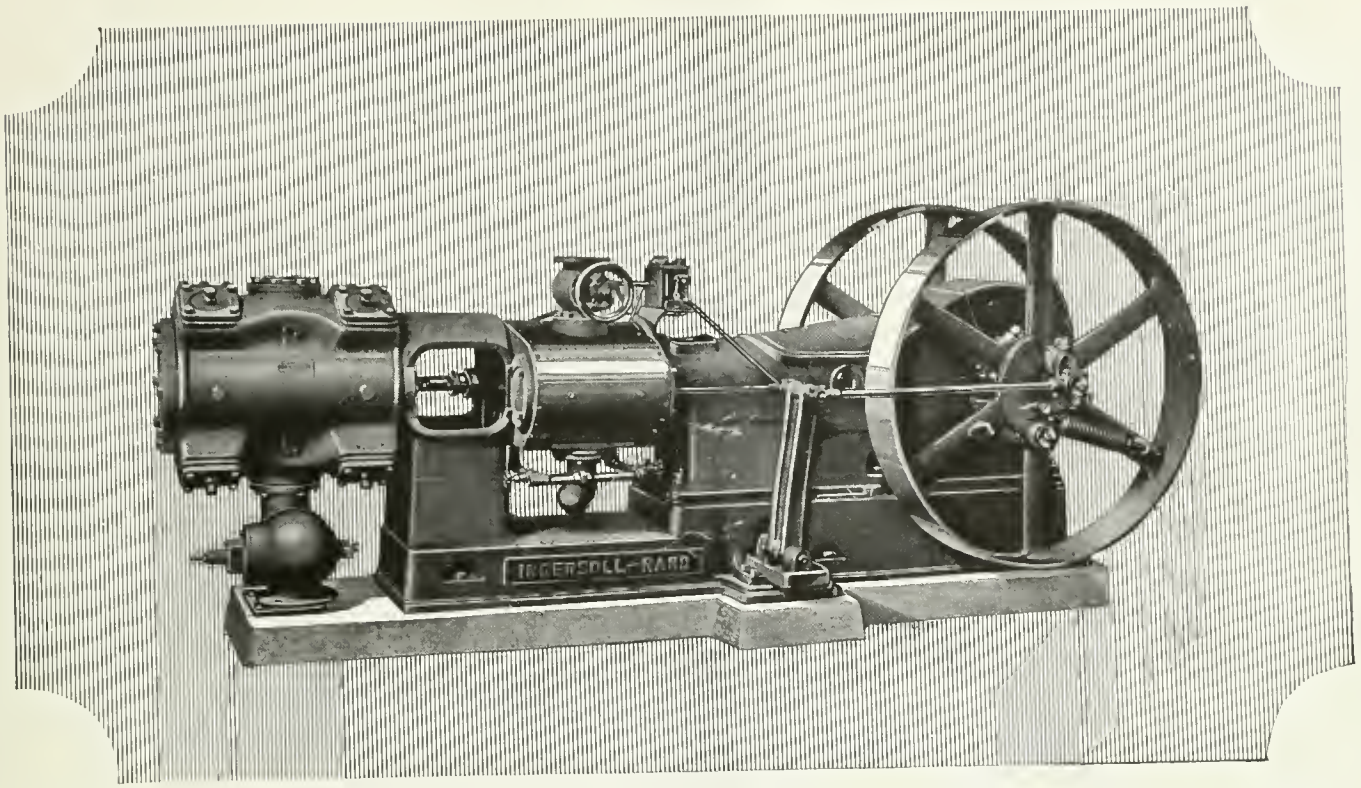
P-118

BOYER PNEUMATIC HAMMERS · · LITTLE GIANT PNEUMATIC AND ELECTRIC TOOLS
CHICAGO PNEUMATIC AIR COMPRESSORS · · VACUUM PUMPS · · PNEUMATIC HOISTS,
GIANT OIL AND GAS ENGINES ROCK DRILLS · · COAL DRILLS

LITTLE GIANT

The World's Standard *Air Drill*

As a matter of reciprocal business courtesy help trace results



Class "FR" Compressors Save Steam

This type of steam driven air compressor has balanced piston steam valve and automatic cut-off flywheel type governor. This combination results in the marked steam economy of these machines—one-third less than that required by a compressor equipped with the ordinary flat valve and throttling steam governor.

With a Class "FR" compressor you are not confined to saturated steam, the piston valve permitting the use of high steam pressures and superheat—affording a still greater steam saving.

The air cylinder has Ingersoll-Rand plate valves and may be provided with suitable unloader to regulate the amount of air compressed.

Let us send you a copy of Bulletin 3131 describing Class "FR" Compressors. We would also be glad to send you a copy of Bulletin 3330 describing "ER" machines which are similar to the Class "FR" but arranged for belt drive.

Ingersoll-Rand Co., 11 Broadway, New York

165 Q. Victoria St., London, E. C. 4

Joplin	Cleveland	Boston	St. Louis
Butte	Pittsburgh	El Paso	Chicago
Juneau	Birmingham	New York	New Orleans
Duluth	Los Angeles	Knoxville	San Francisco
Dallas	Detroit	Scranton	Salt Lake City
Houghton	Denver	Seattle	Philadelphia

Offices the World Over 591-C

Ingersoll-Rand

The Men Who Made the World's Shaft Record

J. D. Matheson, General Foreman (fourth from right in front row, kneeling), attributes the success of this undertaking largely to the efficiency of these men.

WALTER FITCH, JR.
President Walter Fitch, Jr. Co.

Another World's Record

The Same Contractor - Walter Fitch, Jr. Co.
The Same Powder - - Hercules
The New Shaft Record 427½ Feet in 31 Days

In 1916, Walter Fitch, Jr., Co. sank a shaft 261 feet in 31 days for the Chief Consolidated Mining Co., Eureka, Utah, a world's record at that time.

Hercules Dynamite was used.

On August 15, 1921, the same contracting company, sinking another shaft for the same mining company, completed a record of 427½ feet in 31 days. This exceeds, by 117½ feet, the best previous distance ever made.

Again, all of the dynamite used was Hercules.

What greater confidence in the reliability of Hercules Dynamite could be shown? What better demonstration of its performance?

The Fitch Company's continued choice of Hercules for this undertaking, which demanded the utmost efficiency from men and materials, is a significant fact worth remembering.

Write for our book—Hercules Products.

Condensed Data

Size of Shaft—5'9"x15'6"(outside dimensions)
Distance Sunk—427½ feet in 31 days.
Explosives Used—Hercules Gelatin 1. F. 35% 1"x8"
Blasting Caps Used—Hercules No. 8
Average Dynamite Consumption per foot—15¼ lbs.
Average Footage per day—13.8 feet
Labor—Average of 5.7 shaftsmen per shift.
Drilling—Average of 23.9 holes drilled per round. Three rounds drilled per 24 hours.
Hoisting—Average of 72½ buckets of 17 cu. ft. capacity hoisted per shift.
Timbering—Average of 2.8 sets per day by an average of 4.8 timbermen.
Nature of rock—Porphyry and close grained limestone.
Total Delay During Month—13 hours due to failure of power and repairing head frame.

HERCULES POWDER CO.

Allentown, Pa
Birmingham, Ala.
Buffalo, N.Y.
Chattanooga, Tenn.
Chicago, Ill.
Denver, Col.
Duluth, Minn.
Hazleton, Pa
Huntington, W.Va.
Joplin, Mo.
Los Angeles, Cal.
Louisville, Ky
New York City
Norristown, Pa
Pittsburg, Kansas
Pittsburgh, Pa.
Pottsville, Pa.
St. Louis, Mo.
Salt Lake City, Utah
San Francisco, Cal.
Wilkesbarre, Pa.
Wilmington, Del.